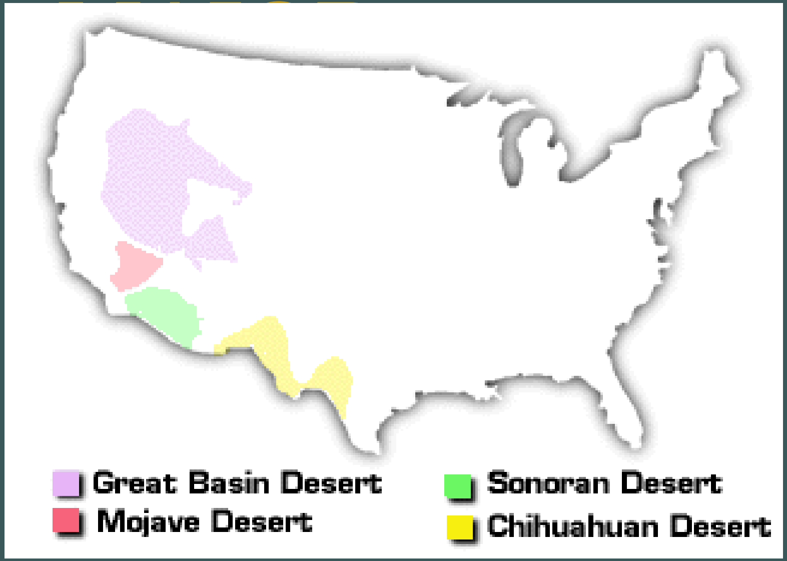
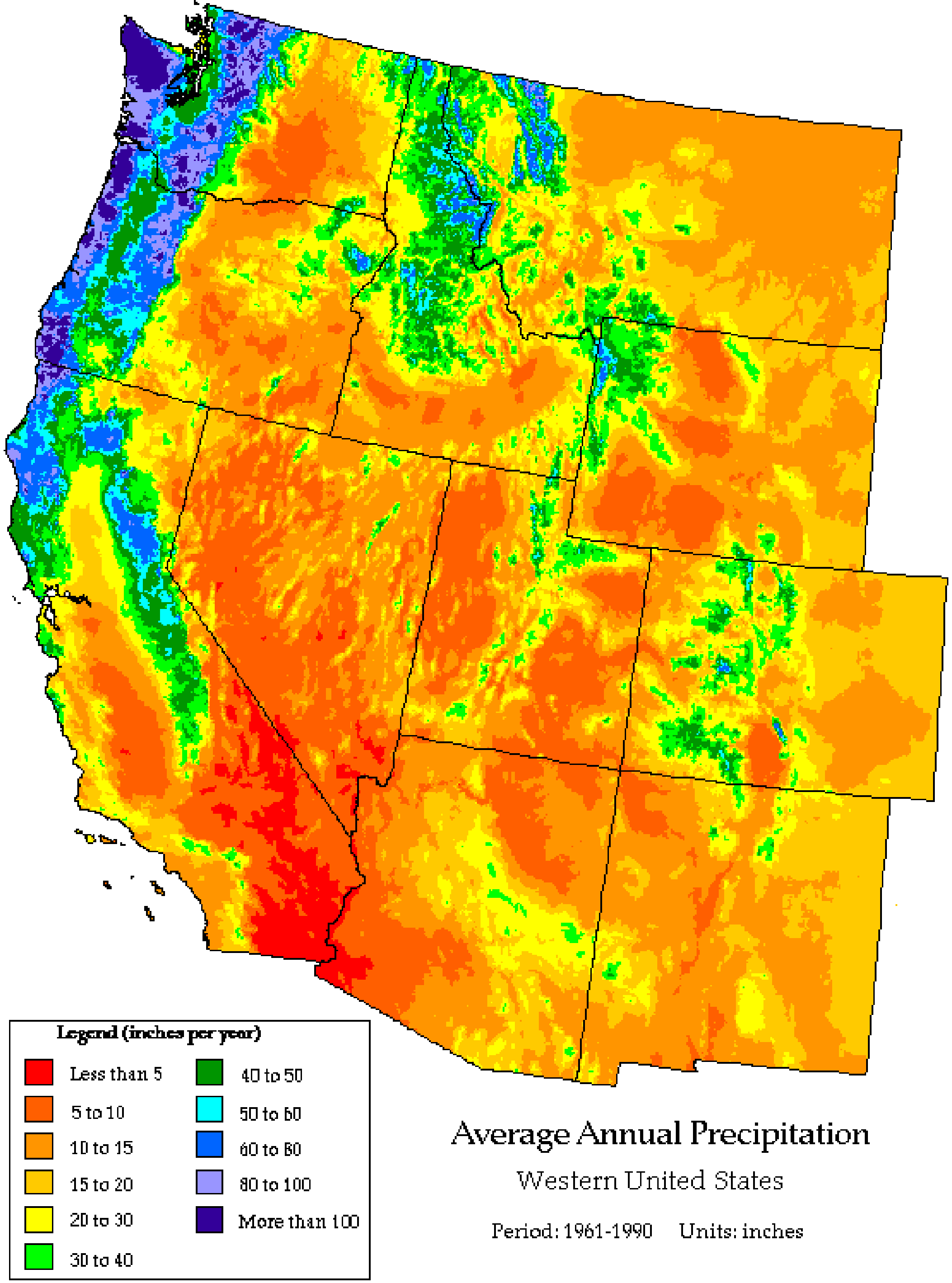
Flood Damage Analysis Issues in the Arid Southwest

By Kathleen M. Bergmann & Michael J.Halisy

AVERAGE ANNUAL RAINFALL IN THE WESTERN UNITED STATES & LOCATION OF


Great Basin Desert
Mojave Desert
Sonoran Desert
Chihuahuan Desert


Legend (inches per year)
Less than 5
5 to 10
10 to 15
15 to 20
20 to 30
30 to 40
40 to 50
50 to 60
60 to 80
80 to 100
More than 100

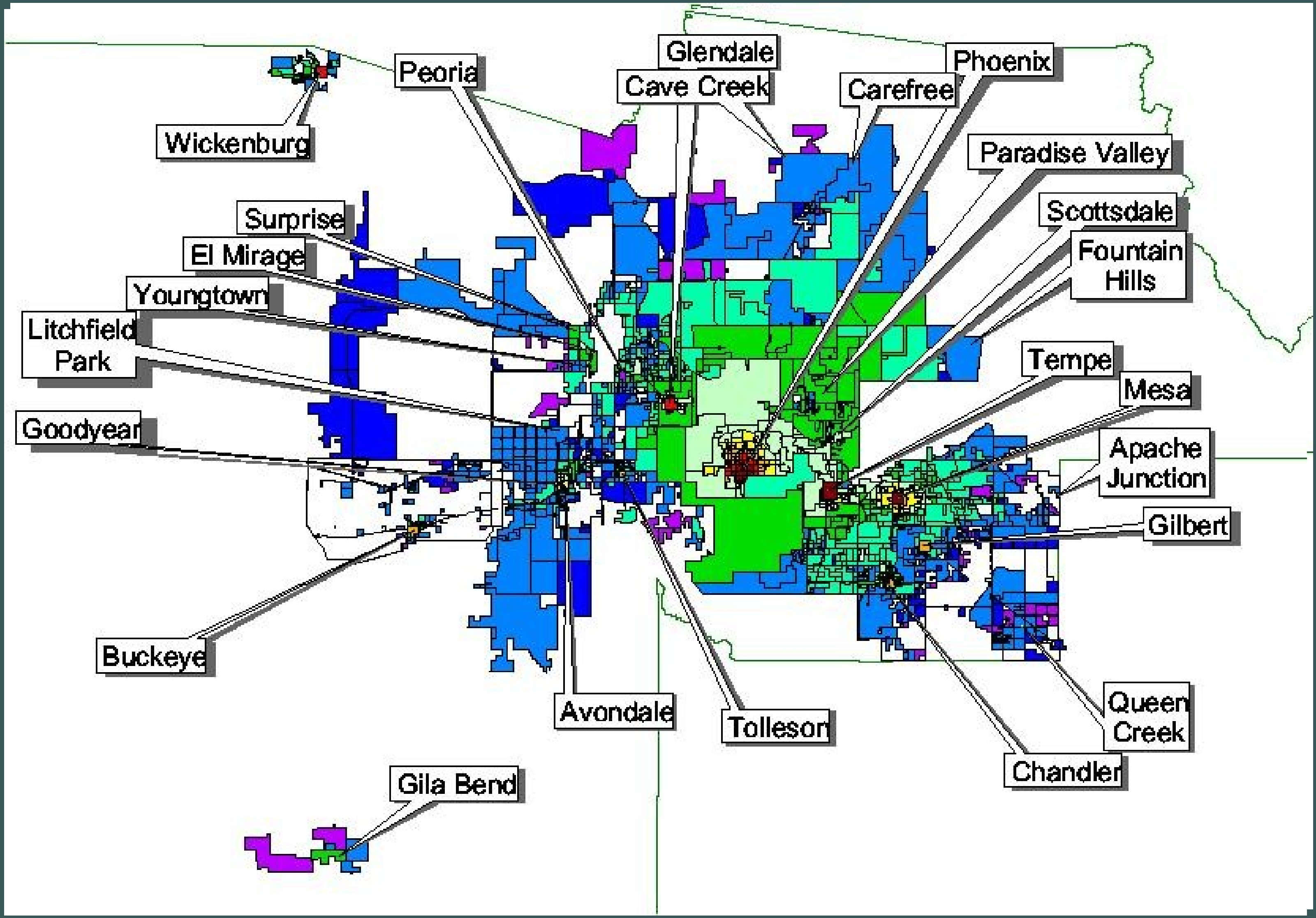
Average Annual Precipitation

Western United States

Period: 1961-1990 Units: inches

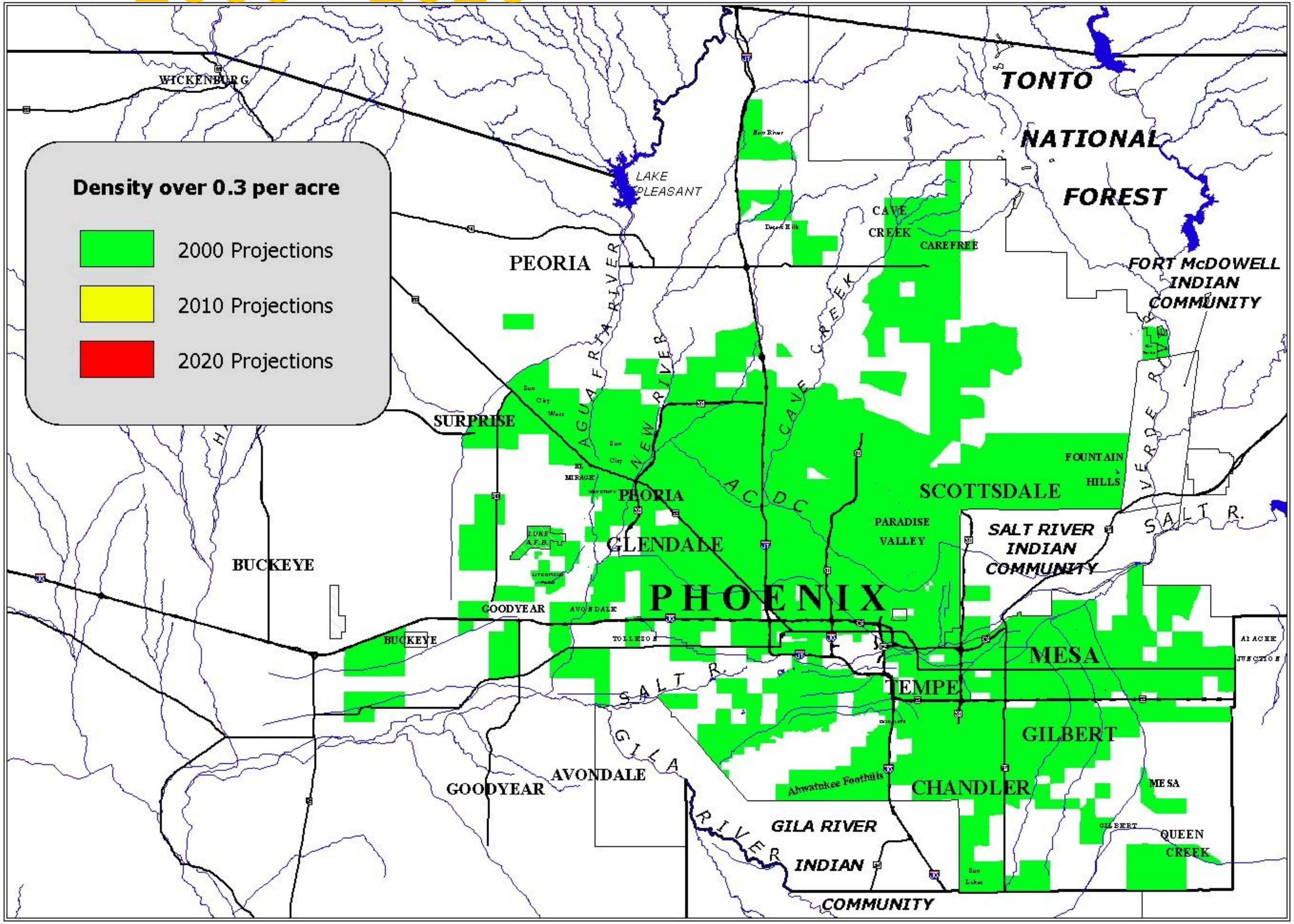
Photo by Greg Lasley

Maricopa County Annexations

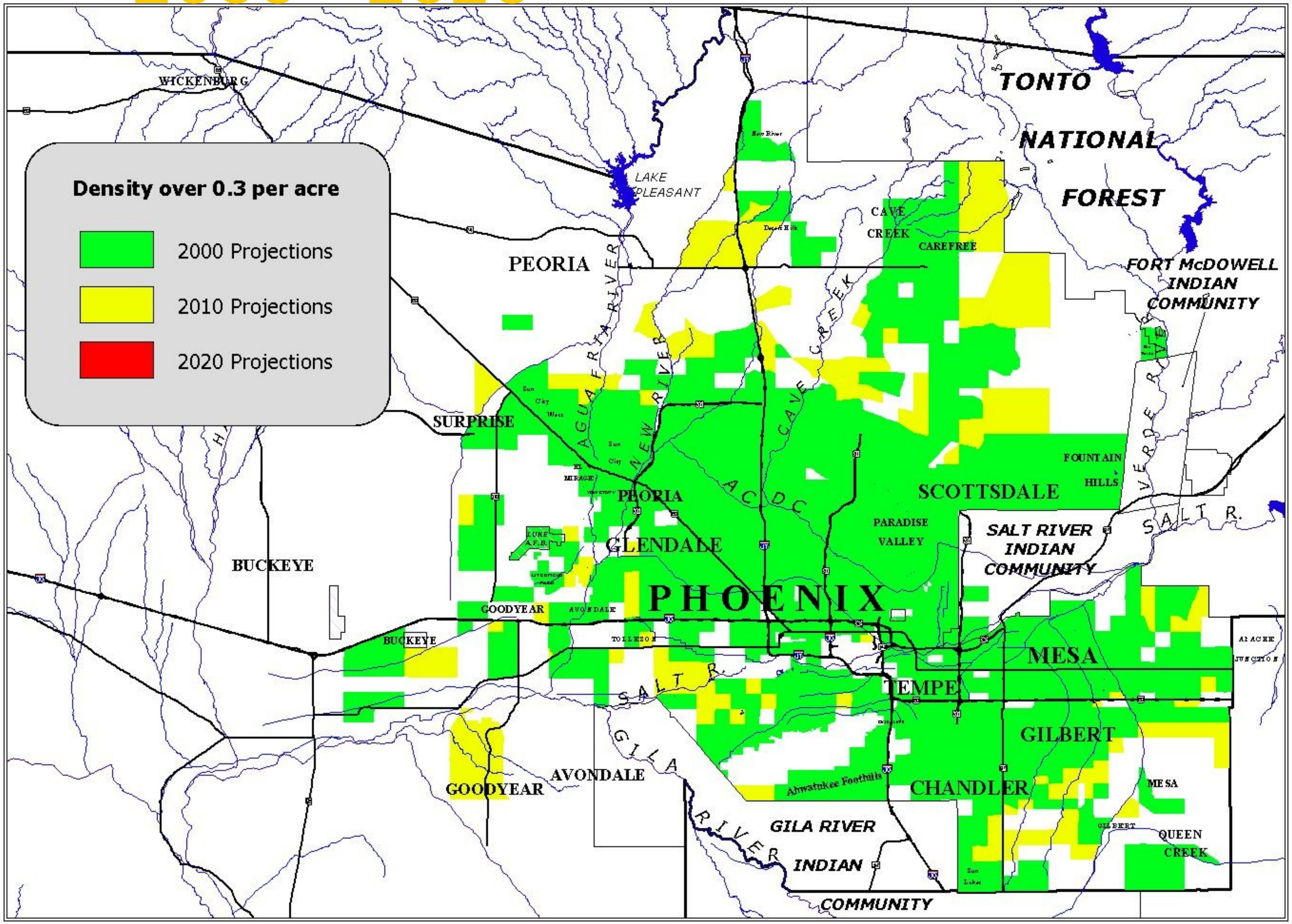

Glendale
Cave Creek
Phoenix
Peoria
Carefree
Wickenburg
Paradise Valley
Scottsdale
Surprise
El Mirage
Fountain Hills
Youngtown
Litchfield Park
Tempe
Mesa
Goodyear
Apache Junction
Gilbert
Buckeye
Avondale
Tolleson
Queen Creek
Chandler
Gila Bend

190 192 194 195 1960 1970 198 199 199 Toda

Population Density Projections, 2000 - 2020


Density over 0.3 per acre
🟩 2000 Projections
🟨 2010 Projections
🟥 2020 Projections
WICKENBURG
LAKE PLEASANT
TONTO
NATIONAL
FOREST
CAVE CREEK
CAREFREE
FORT McDOWELL INDIAN COMMUNITY
PEORIA
AGUA FRIA RIVER
NEW RIVER
CAVE CREEK
SURPRISE
Sun City West
Sun City
EL MIRAGE
PEORIA
GLENDALE
LUKE A.F.B.
ACDC
SCOTTSDALE
FOUNTAIN HILLS
VERDE RIVER
PARADISE VALLEY
SALT RIVER INDIAN COMMUNITY
SALT R.
BUCKEYE
PHOENIX
GOODYEAR
AVONDALE
TOLLESON
BUCKEYE
APACHE JUNCTION
MESA
TEMPE
SALT R.
GILA
GILBERT
Ahwatukee Foothills
CHANDLER
MESA
GILBERT
QUEEN CREEK
GOODYEAR
AVONDALE
GILA RIVER
GILA RIVER INDIAN COMMUNITY
Sun Lakes

Population Density Projections, 2000 - 2020


Density over 0.3 per acre
🟩 2000 Projections
🟨 2010 Projections
🟥 2020 Projections
WICKENBURG
LAKE PLEASANT
TONTO
NATIONAL
FOREST
CAVE CREEK
CAREFREE
PEORIA
FORT McDOWELL INDIAN COMMUNITY
AGUA FRIA RIVER
NEW RIVER
CAVE CREEK
VERDE RIVER
SURPRISE
Sun City West
Sun City
EL MIRAGE
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FOUNTAIN HILLS
SCOTTSDALE
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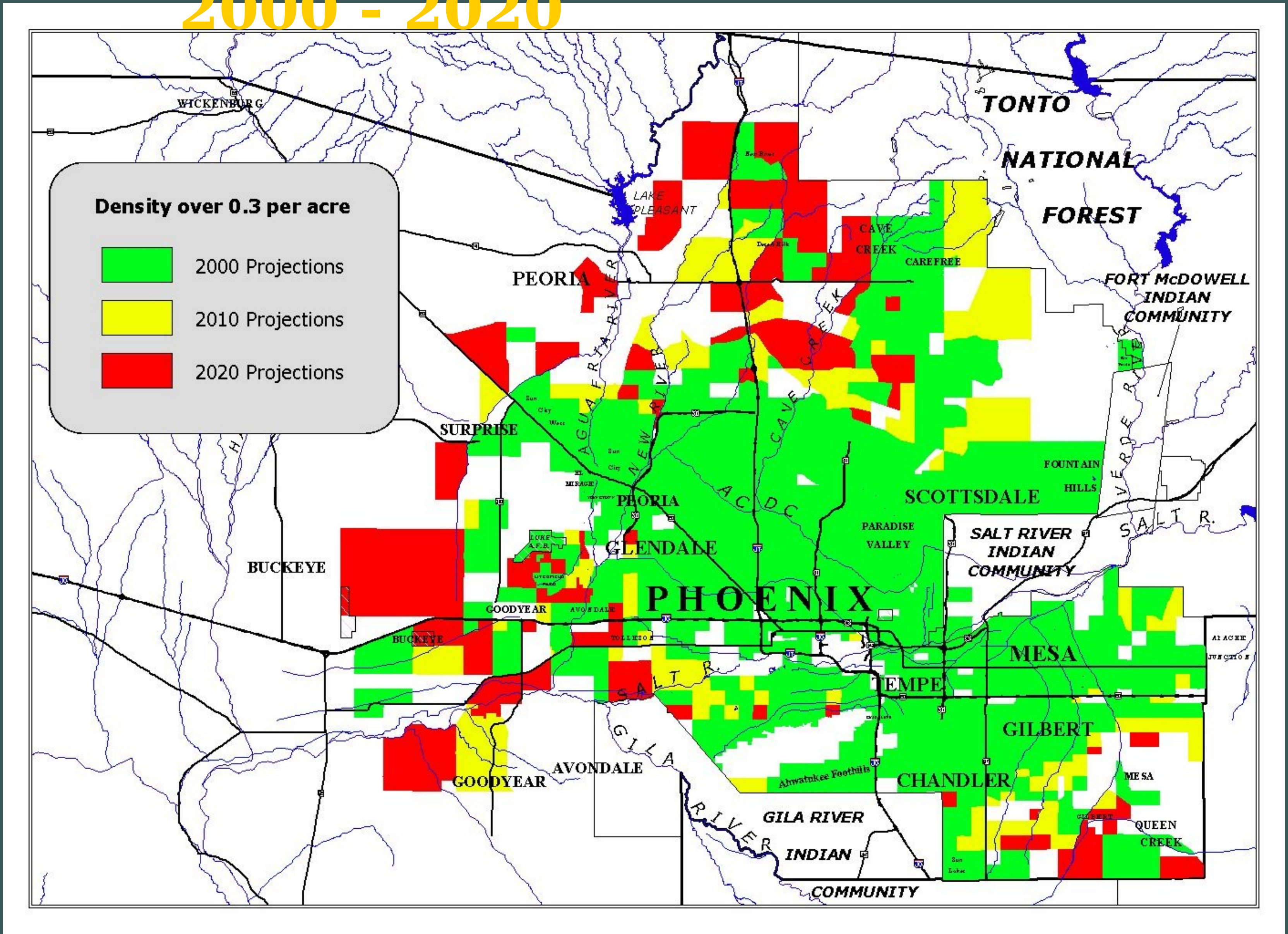
SALT R.
GILBERT
GILA RIVER
Ahwatukee Foothills
CHANDLER
MESA
GOODYEAR
AVONDALE
GILA RIVER INDIAN COMMUNITY
GILBERT
QUEEN CREEK
Sun Lakes

Population Density Projections, 2000 - 2020


Density over 0.3 per acre
🟩 2000 Projections
🟨 2010 Projections
🟥 2020 Projections
WICKENBURG
LAKE PLEASANT
TONTO
NATIONAL
FOREST
CAVE CREEK
CAREFREE
FORT McDOWELL INDIAN COMMUNITY
PEORIA
AGUA FRIA RIVER
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EL MIRAGE
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SALT R.
PARADISE VALLEY
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BUCKEYE
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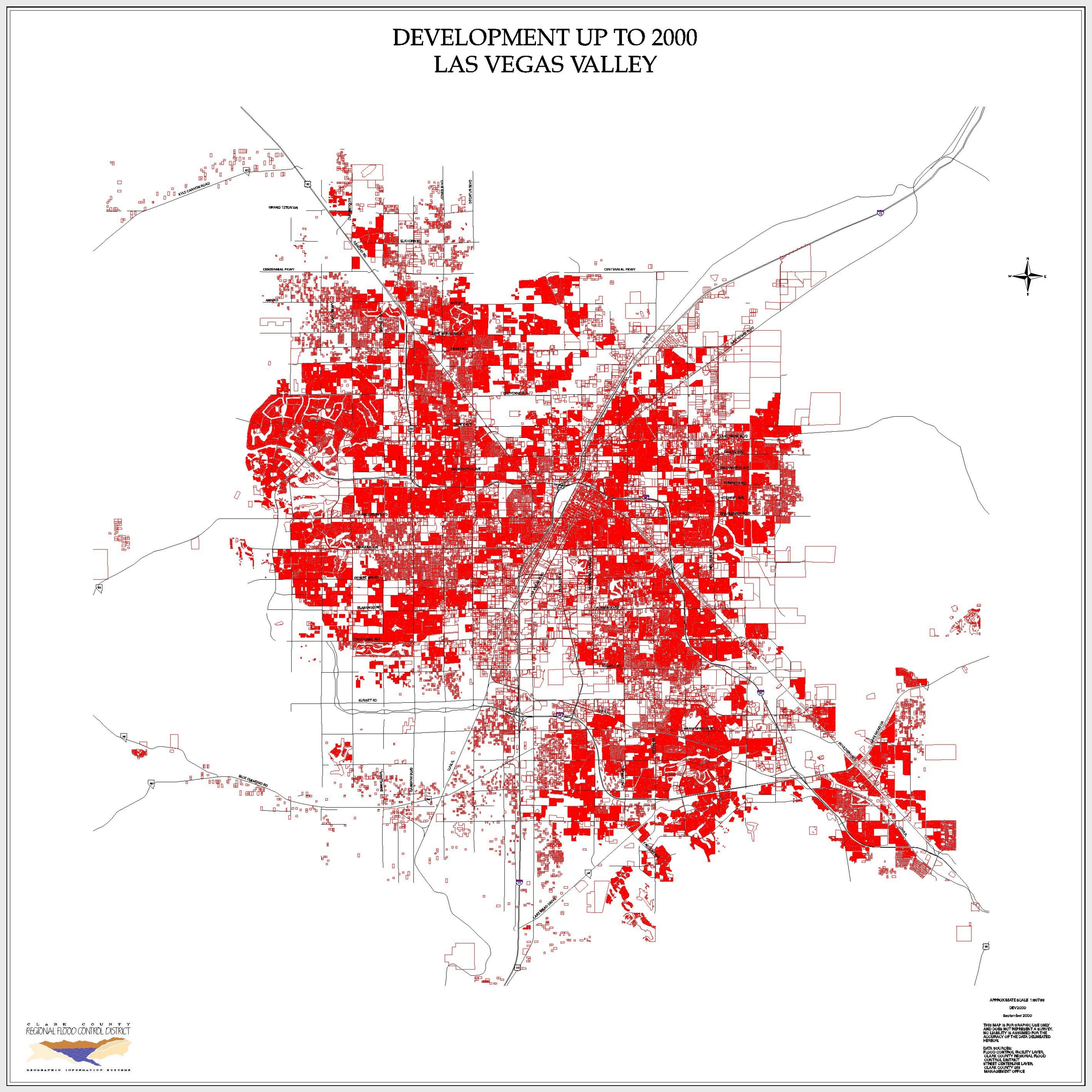
MESA
APACHE JUNCTION
TEMPE
GILBERT
GILA
AVONDALE
GOODYEAR
Ahwatukee Foothills
CHANDLER
MESA
GILA RIVER INDIAN COMMUNITY
RIVER
QUEEN CREEK
GILBERT
Sun Lakes



DEVELOPMENT UP TO 2000
LAS VEGAS VALLEY

APPROXIMATE SCALE 1:80788

DEV2000

September 2000

THIS MAP IS FOR GRAPHIC USE ONLY AND DOES NOT REPRESENT A SURVEY. NO LIABILITY IS ASSUMED FOR THE ACCURACY OF THE DATA DELINEATED HEREON.

DATA SOURCES:
FLOOD CONTROL FACILITY LAYER, CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
STREET CENTERLINE LAYER, CLARK COUNTY GIS MANAGEMENT OFFICE

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT
GEOGRAPHIC INFORMATION SYSTEMS

Pop 47,000

Pop 116,00

Pop 262,00

Pop 444,00

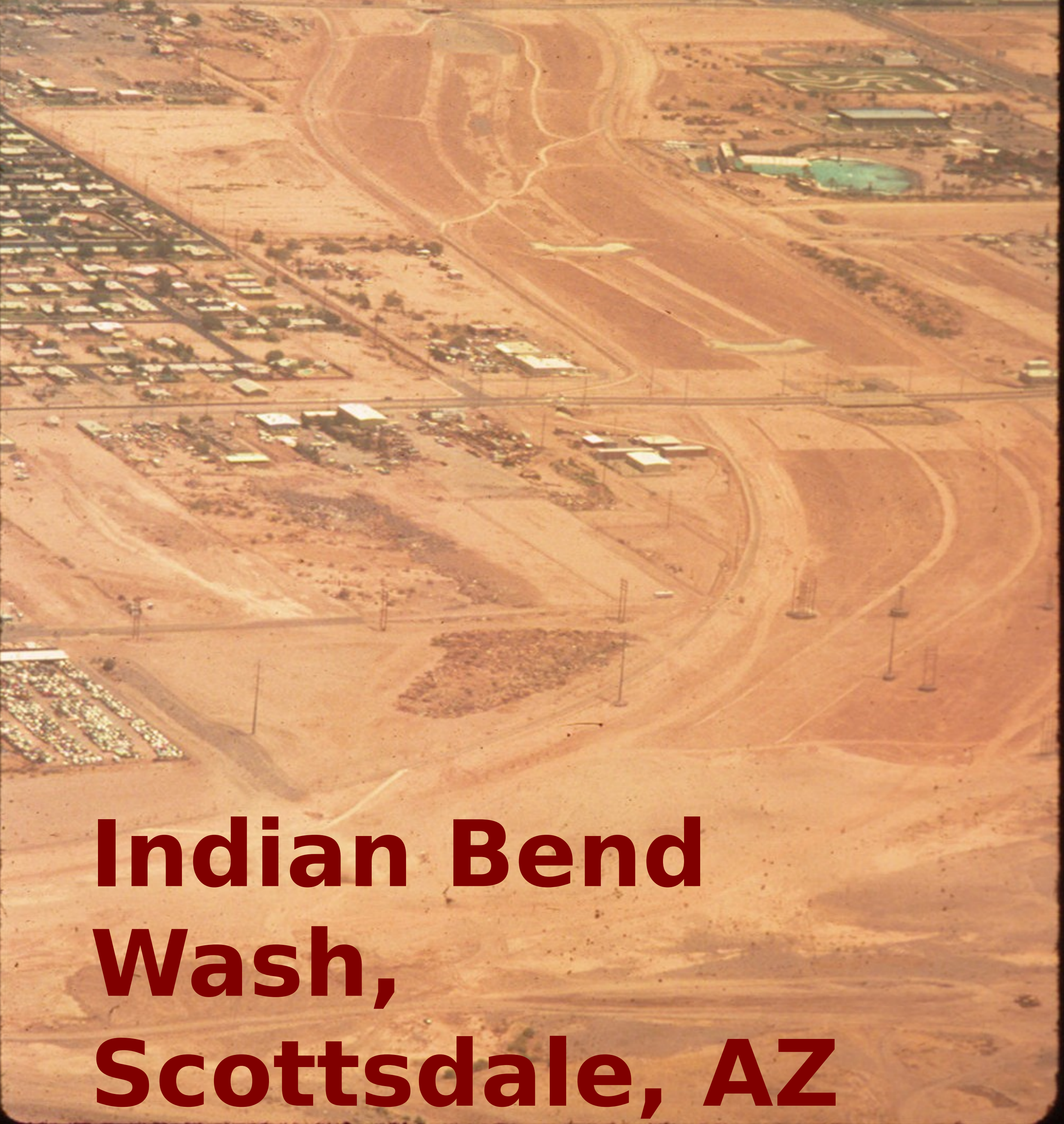
Pop 708,00

Pop 1,300,00

Urban Flooding

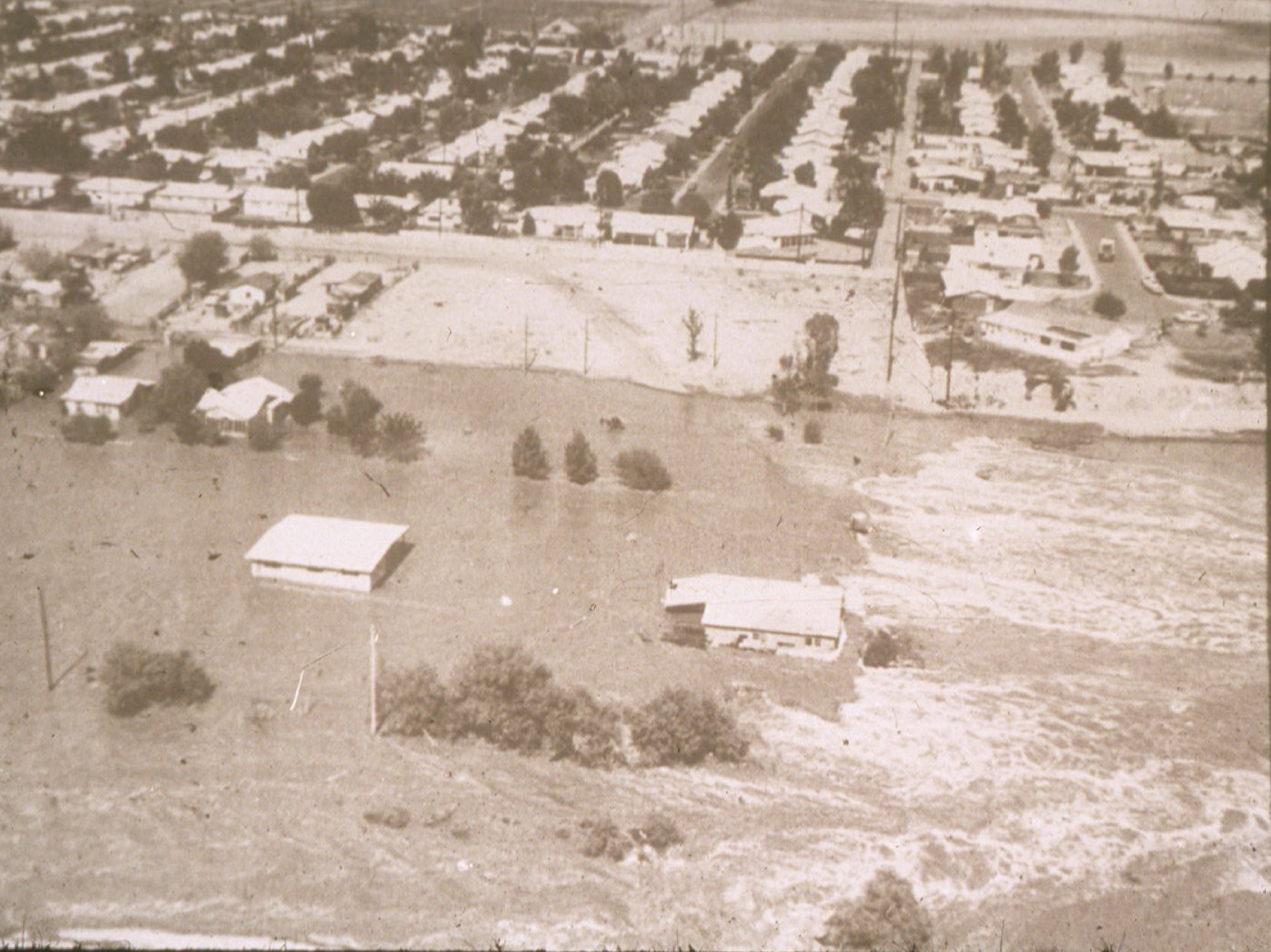
Indian Bend Wash, Scottsdale, AZ

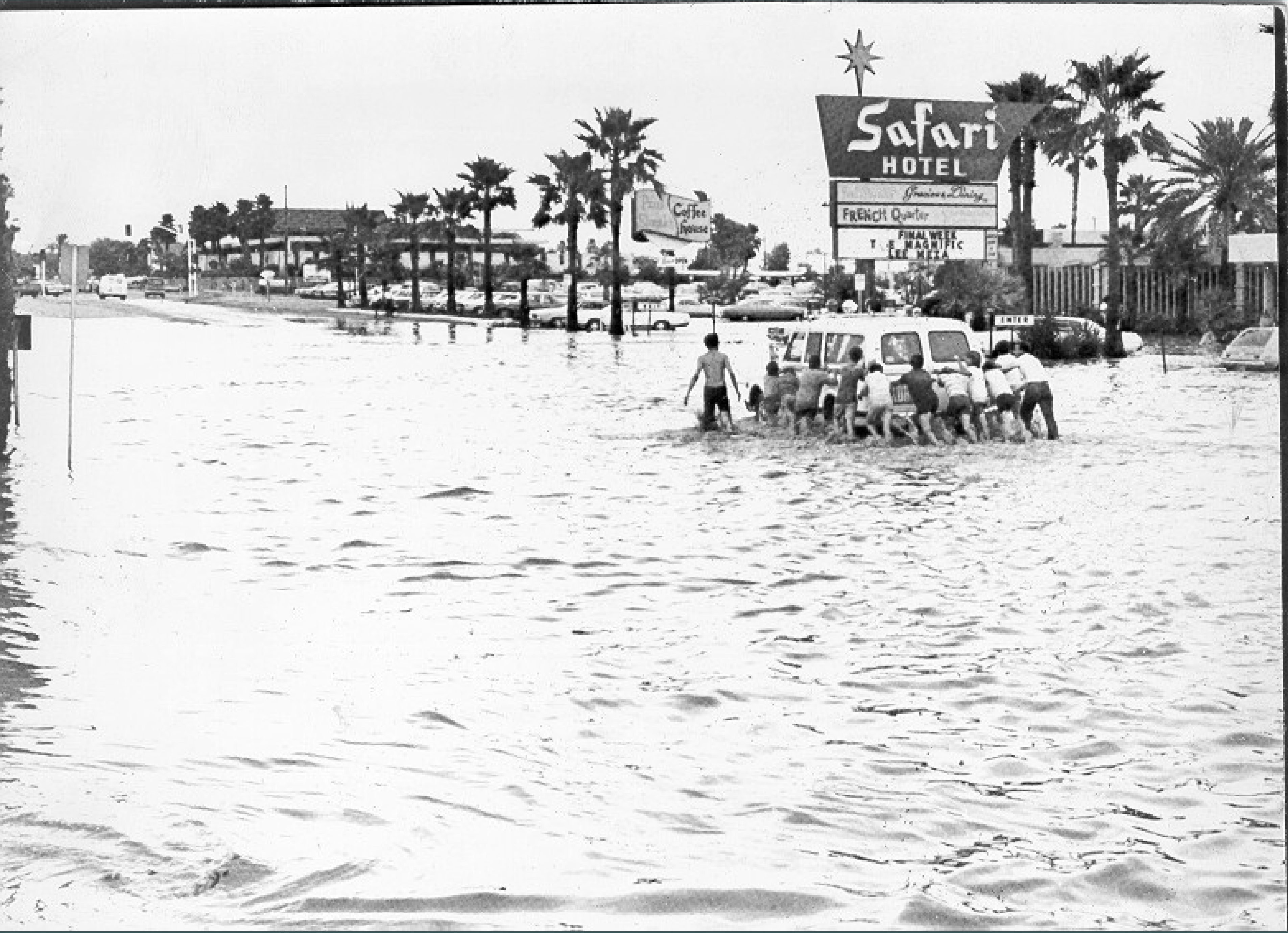
Tropicana Flamingo, Las Vegas, Nevada



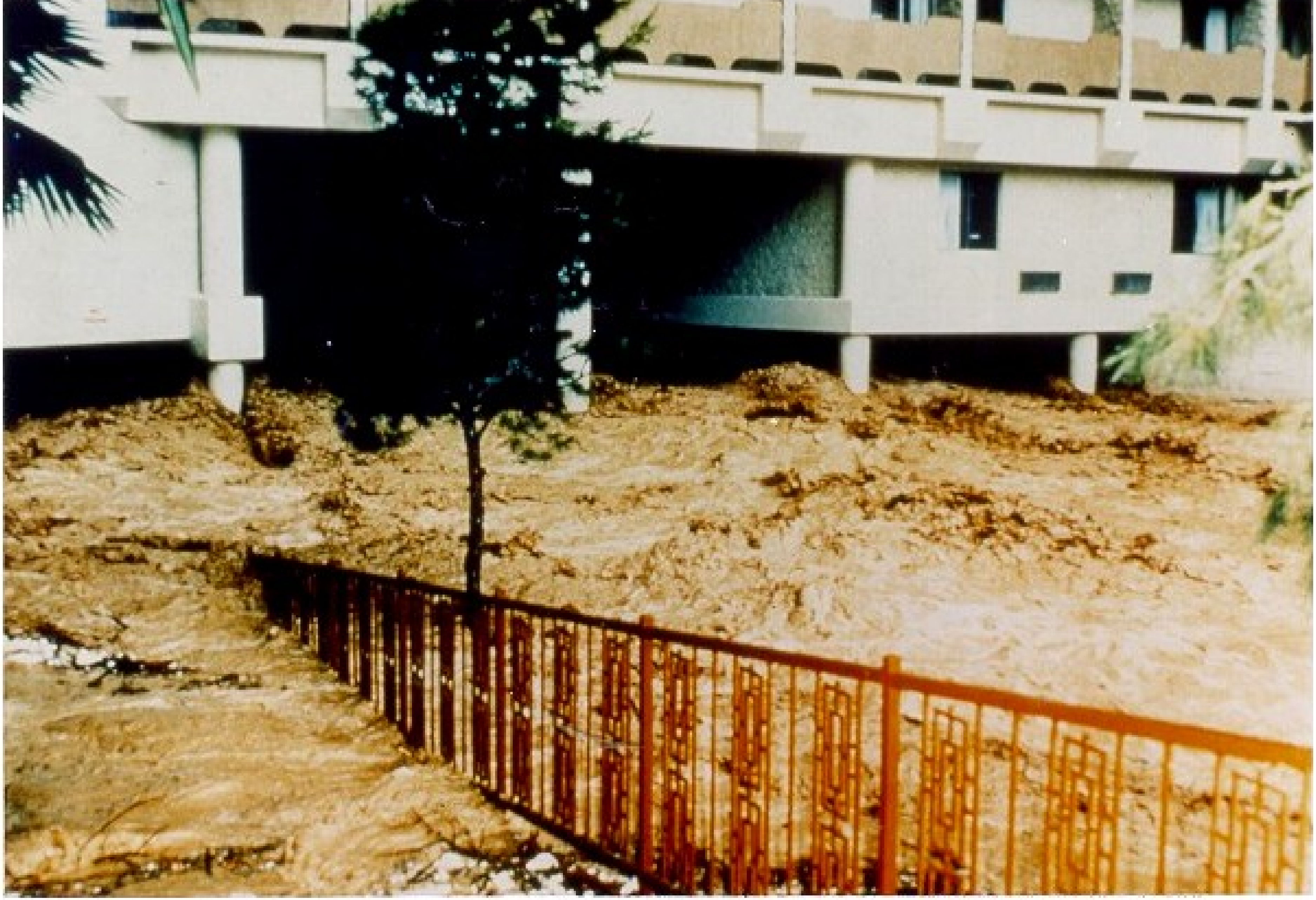
Indian Bend Wash, Scottsdale, AZ

Indian Bend Wash once cut a barren sandy swath through the City of Scottsdale




Safari
HOTEL
Gracious Dining
FRENCH Quarter
FINAL WEEK
T E MAGNIFIC
LEE MEZA
Coffee House
ENTER

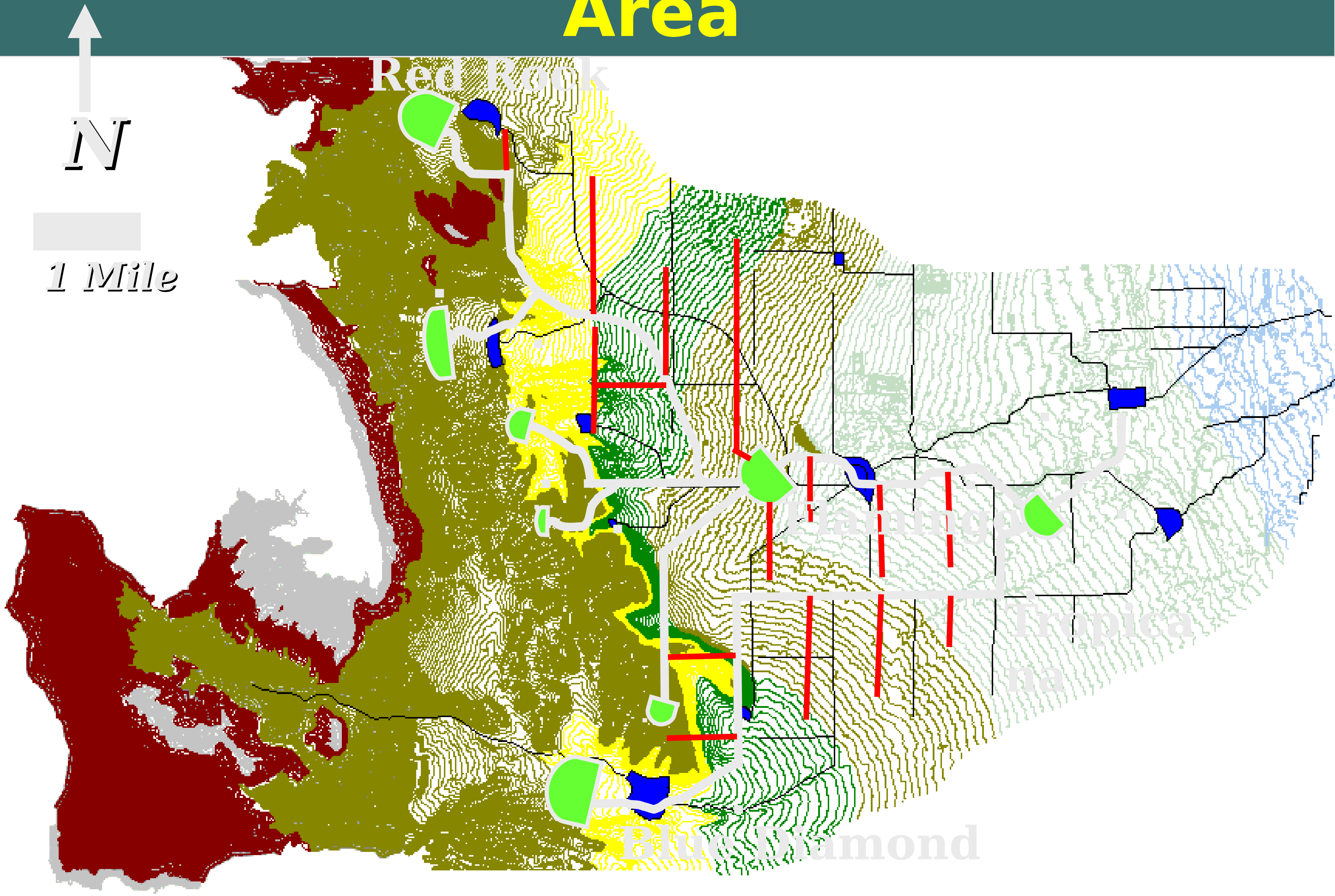
TROPICANA FLAMINGO LAS VEGAS, NV



1983 – Imperial Palace looking upstream

Las Vegas Flood of July 1999

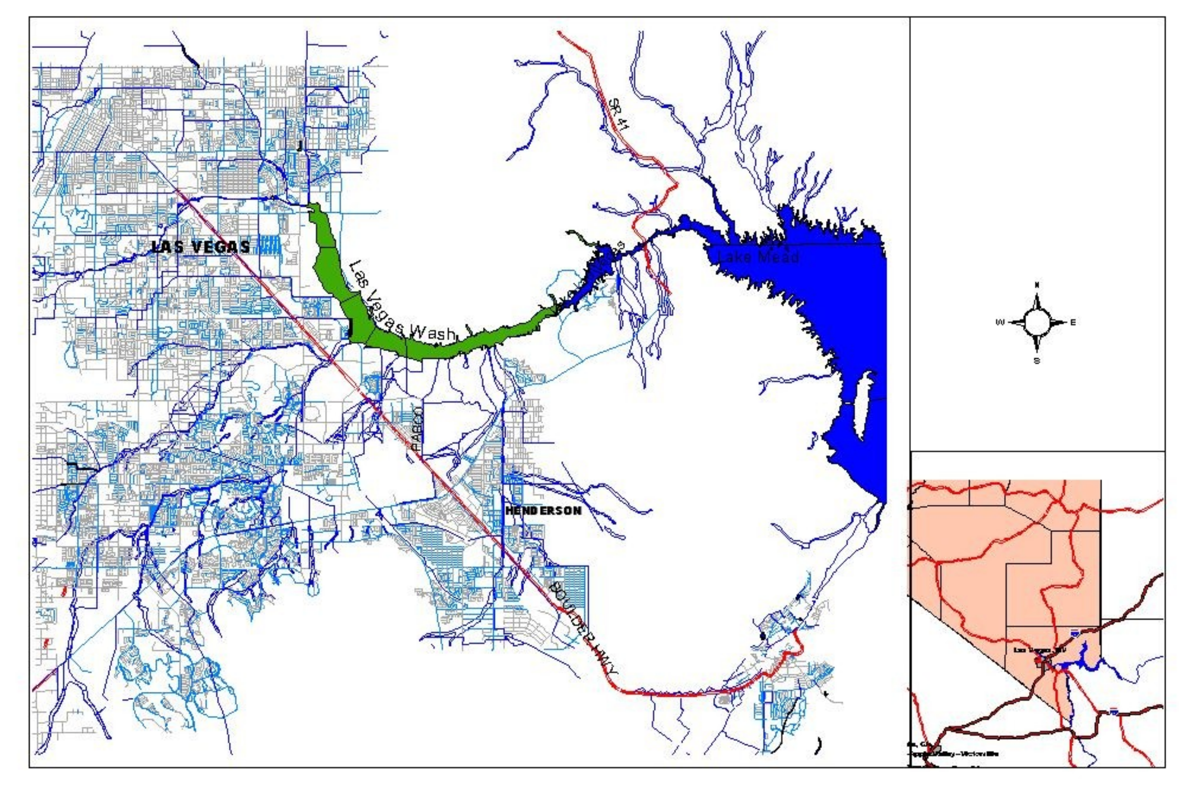
TROPICANA FLAMINGO Project Area


N
1 Mile
Red Rock
Flamingo
Tropicana
Blue Diamond

Sedimentation and Channel Incision

Las Vegas Wash, Henderson, Nevada

Las Vegas Wash


LAS VEGAS
Las Vegas Wash
SR 41
Lake Mead
N
W
E
S
PABCO
HENDERSON
BOULDER HWY
Las Vegas, NV
Apple Valley – Victorville

Historic Conditions 1975

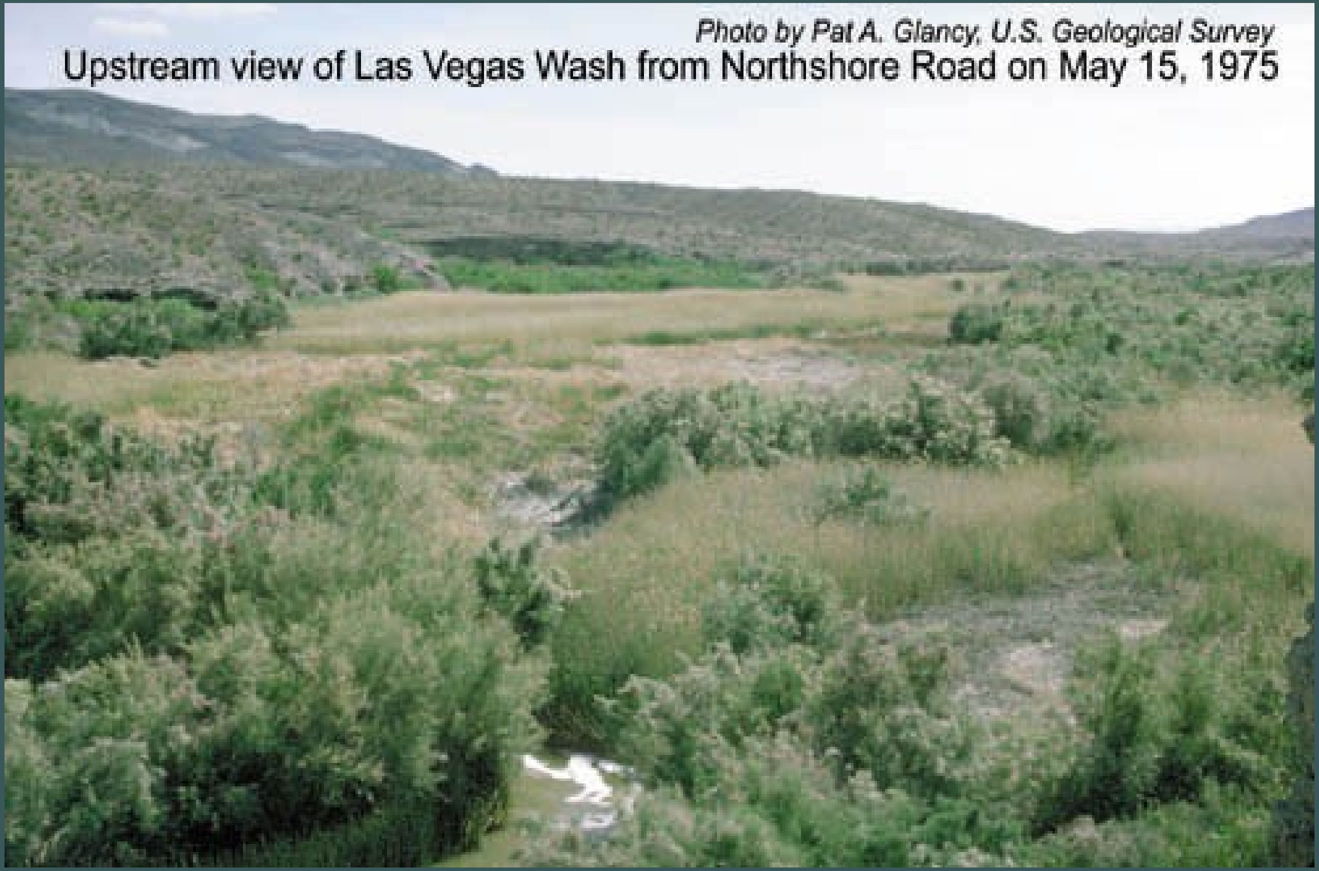


Photo by Pat A. Glancy, U.S. Geological Survey

Upstream view of Las Vegas Wash from Northshore Road on May 15, 1975

Existing Conditions 1999

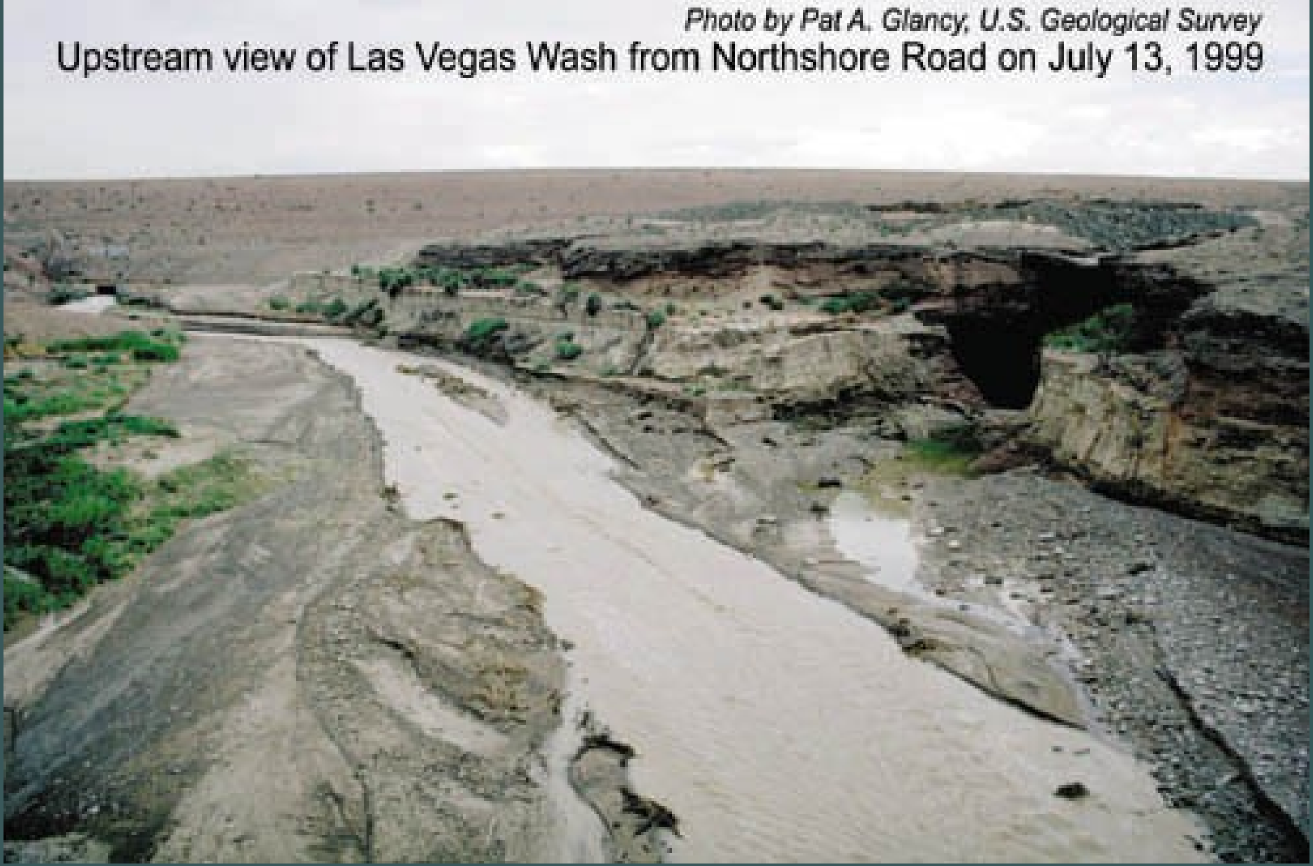
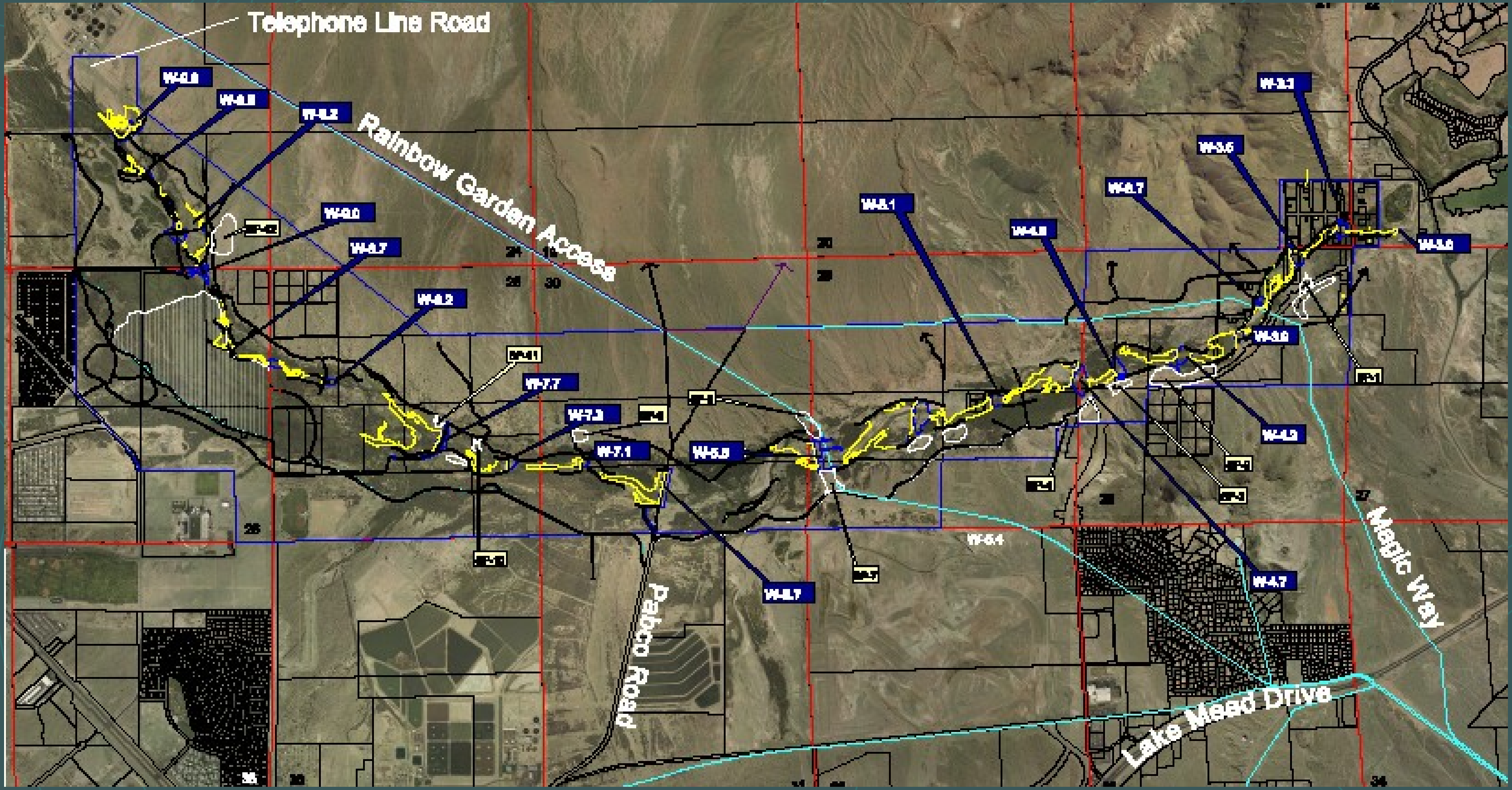


Photo by Pat A. Glancy, U.S. Geological Survey

Upstream view of Las Vegas Wash from Northshore Road on July 13, 1999

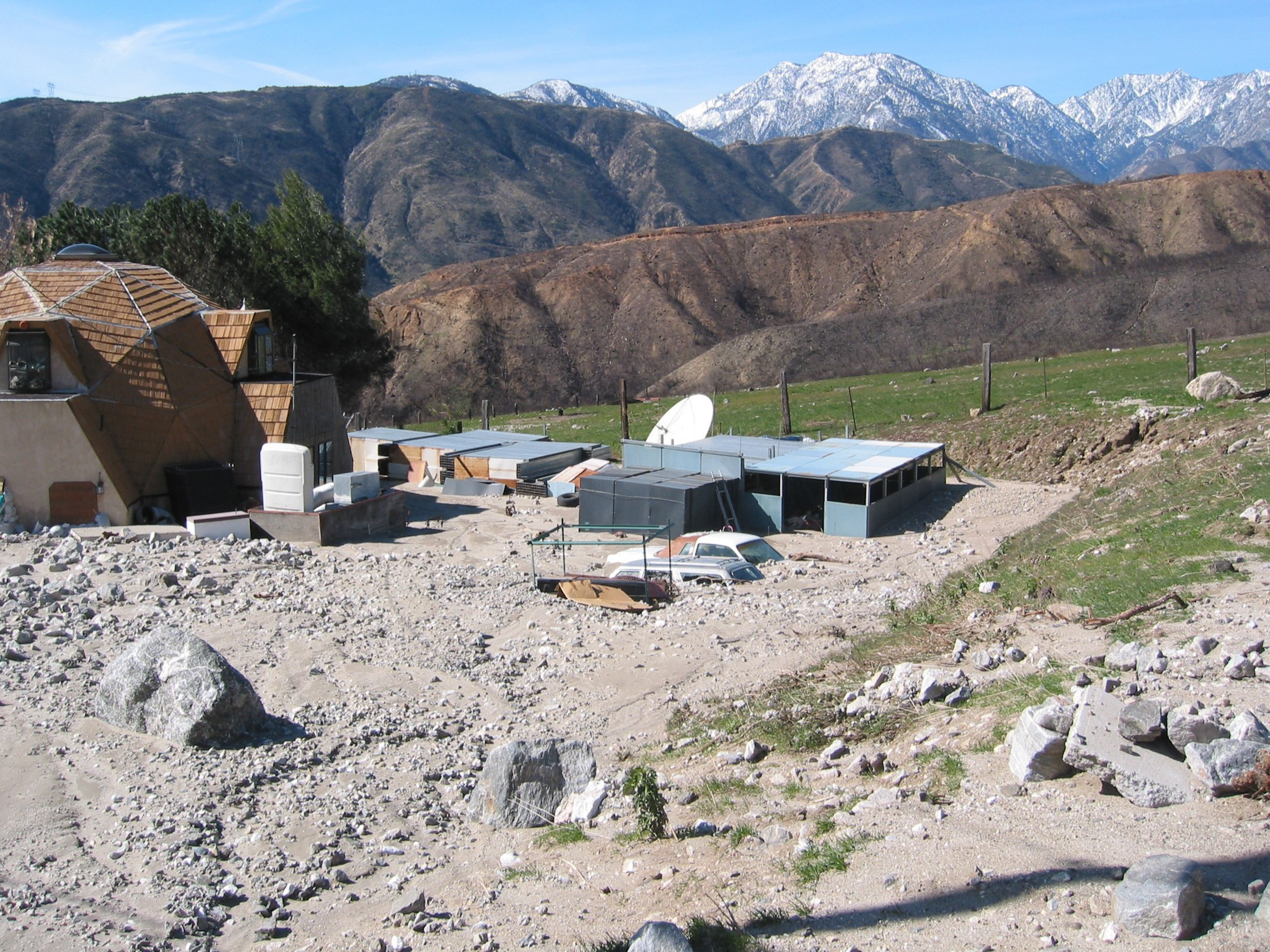
Grade Control Plan

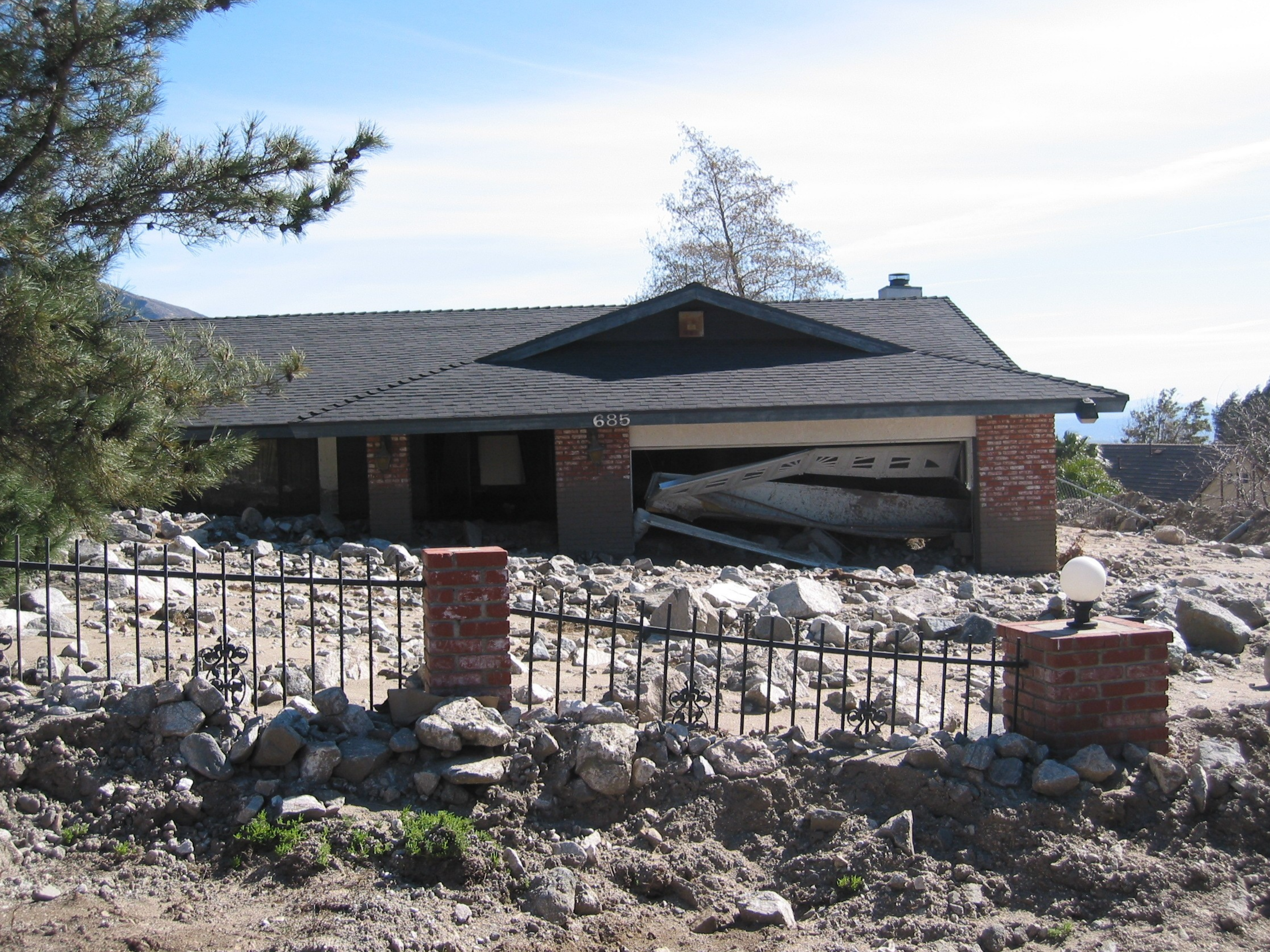


Telephone Line Road
Rainbow Garden Access
W-9.2
W-9.0
W-8.7
W-8.2
W-7.7
W-7.3
W-7.1
W-6.7
W-5.4
W-5.1
W-4.7
W-3.6
Pabco Road
Lake Mead Drive
Magic Way

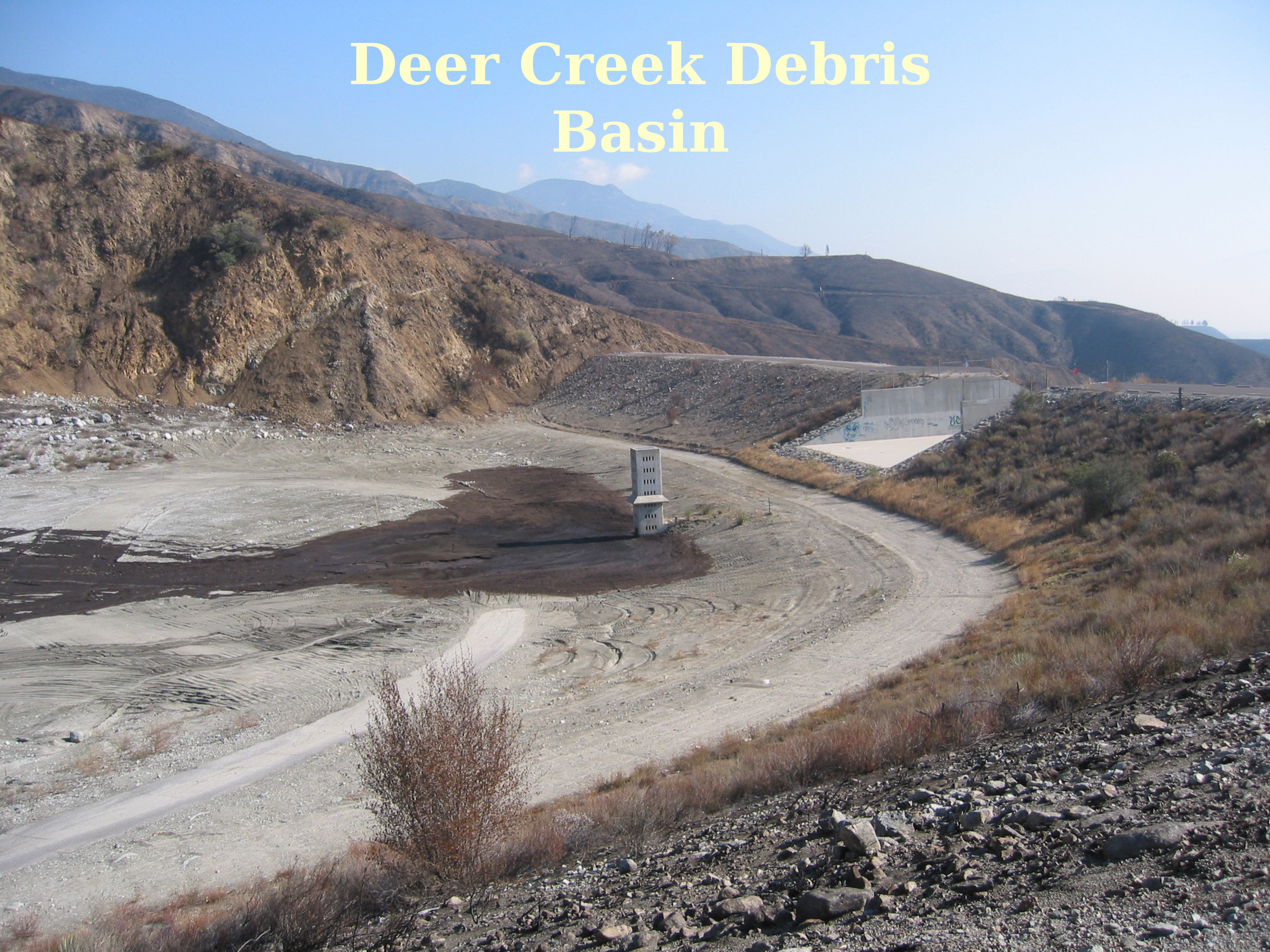
Debris Flows Following Wildfires

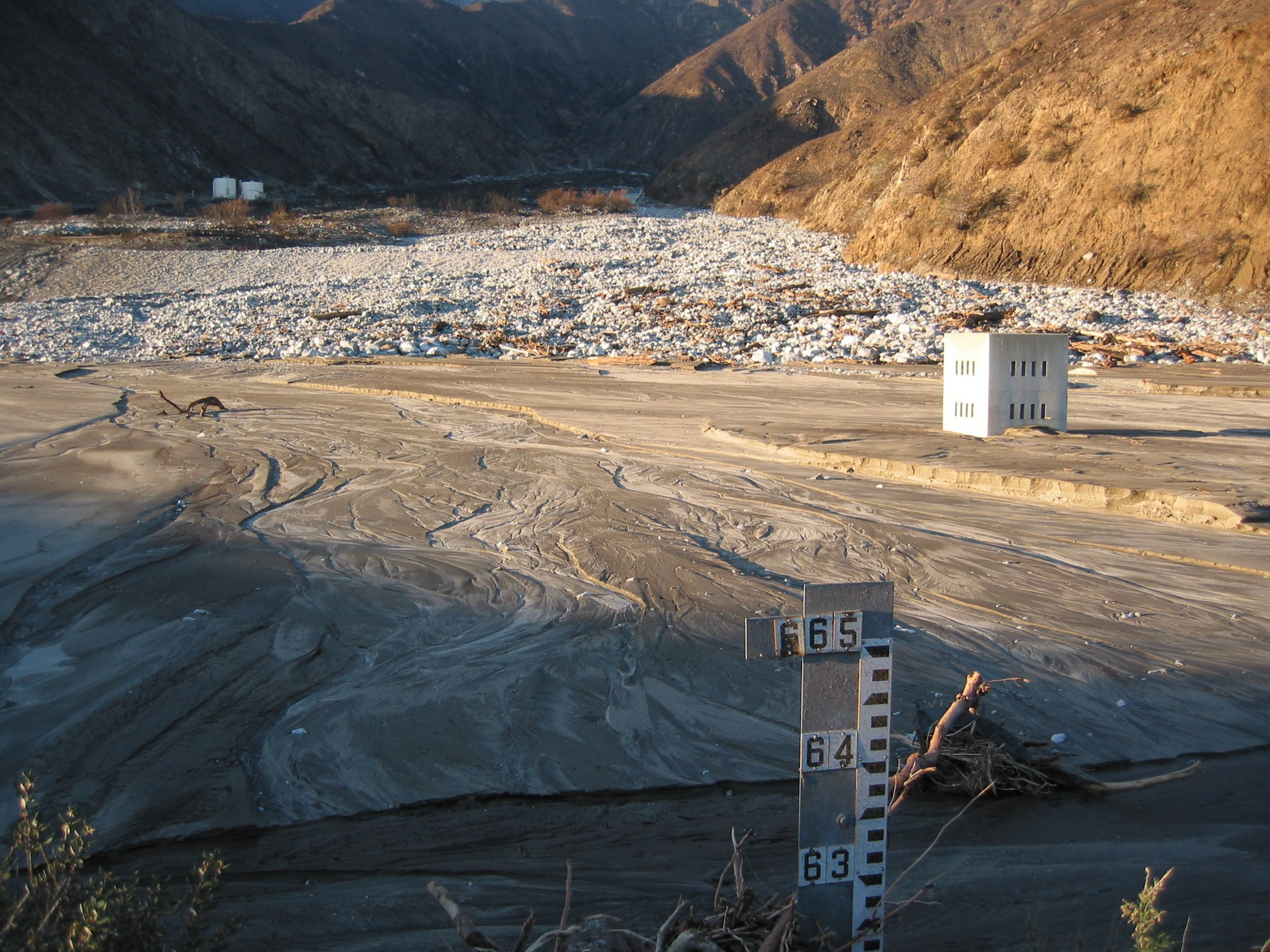
- Wildfires in New Mexico (Los Alamos, 2001), Arizona (Rodeo-Chedeski, 2002), and California (5 counties, 2003)
- Deer Creek, San Bernadino County
  Calif




685

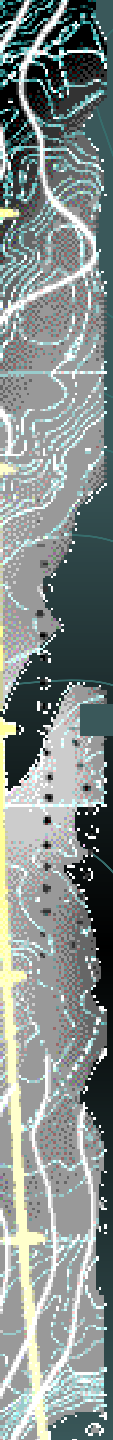
Deer Creek Debris Basin



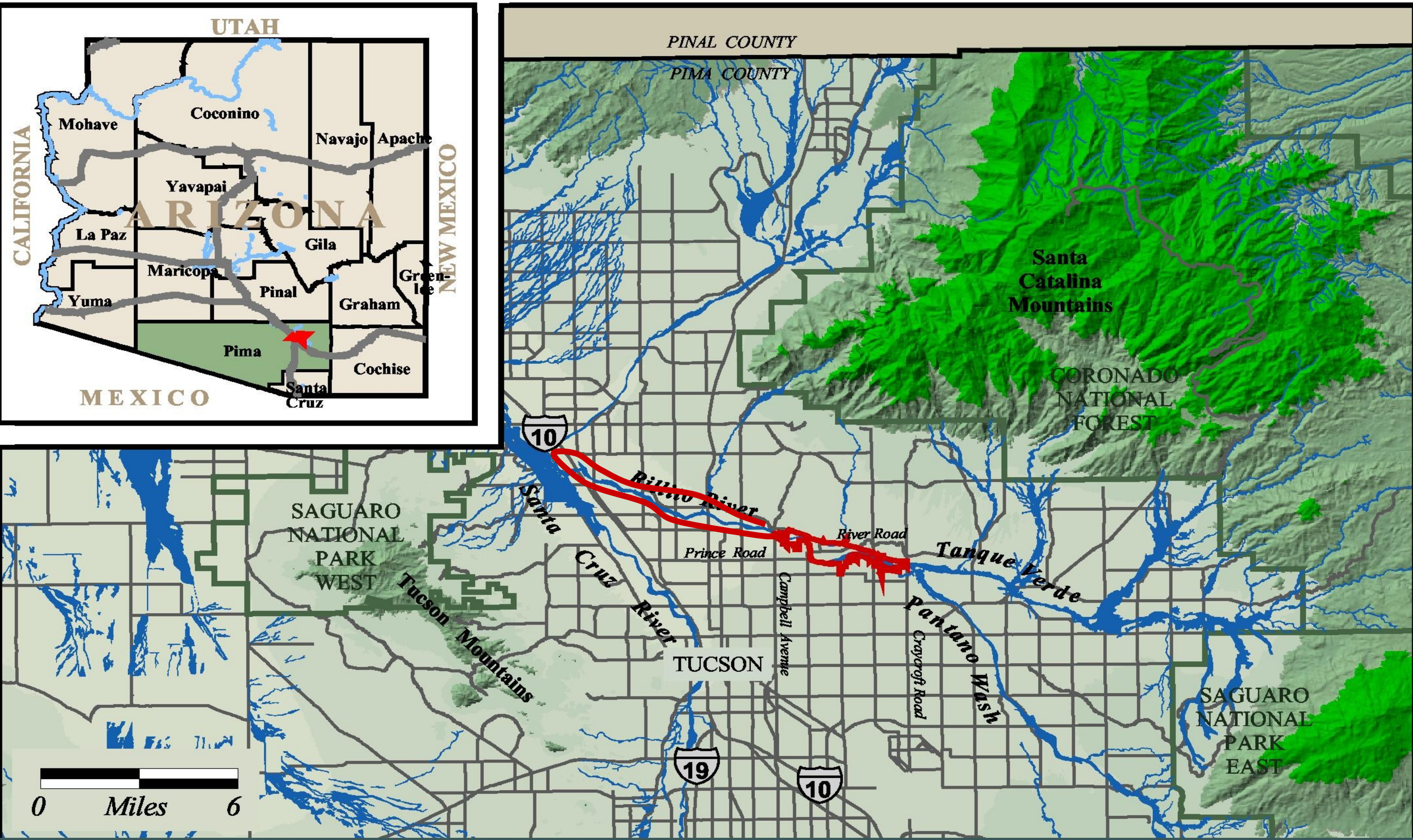

665
64
63

Lateral Channel Migration – Channel Incision and Friable Soils

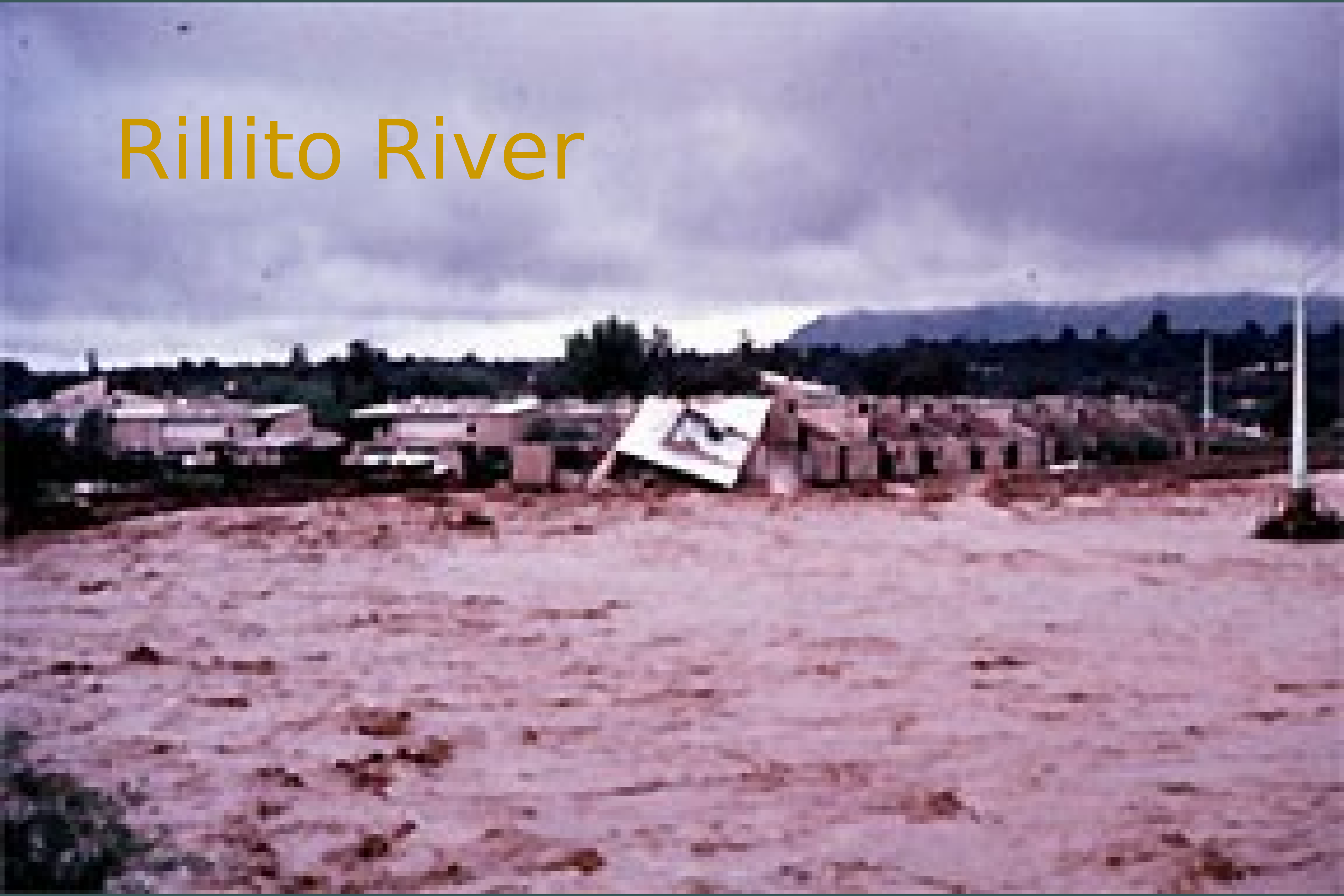
Rillito River, Tucson, Pima County, Arizona

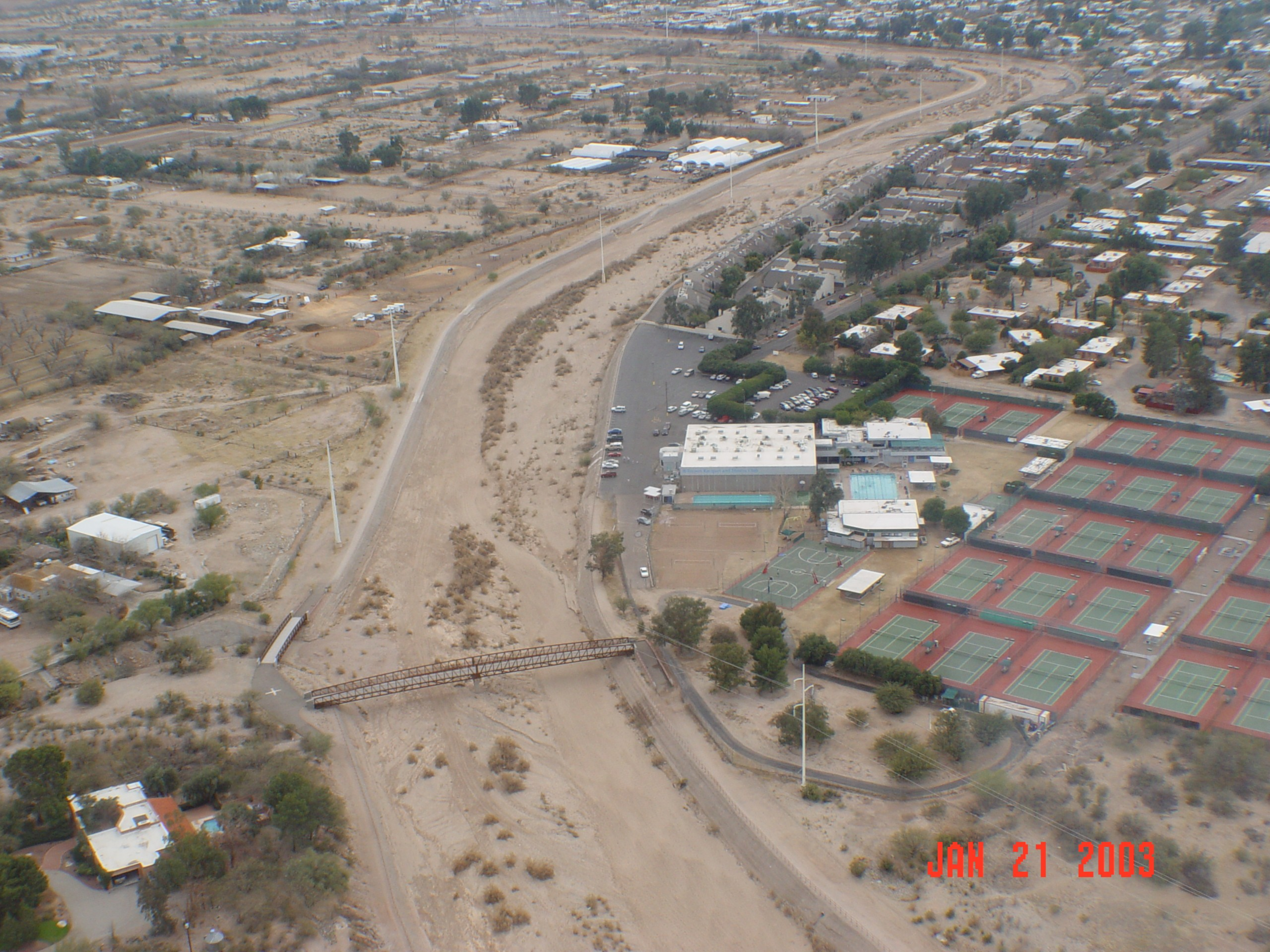


RILLITO RIVER, PIMA COUNTY

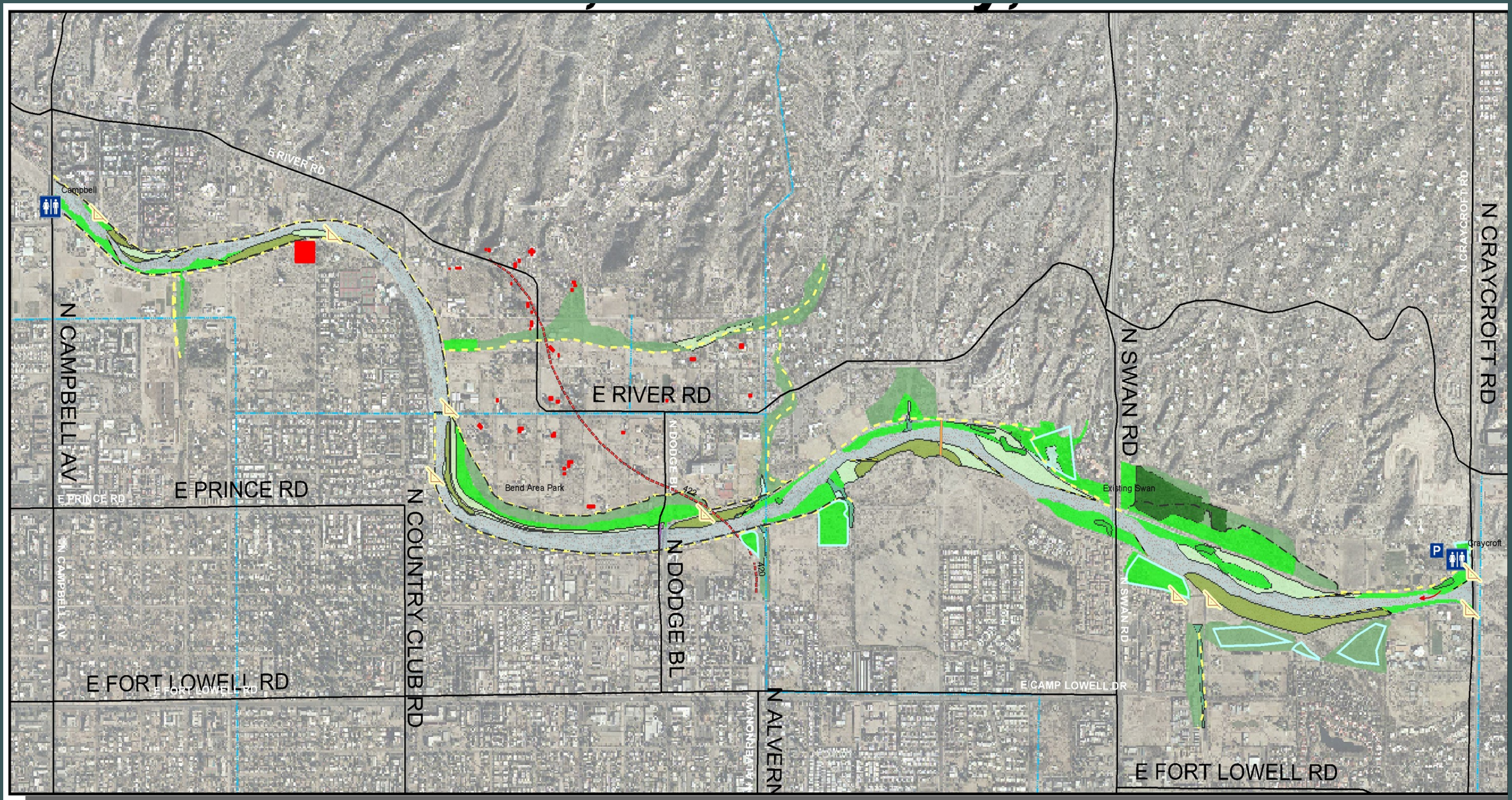

UTAH
CALIFORNIA
NEW MEXICO
MEXICO
ARIZONA
Mohave
Coconino
Navajo
Apache
Yavapai
La Paz
Gila
Maricopa
Pinal
Green-lee
Yuma
Graham
Pima
Cochise
Santa Cruz
PINAL COUNTY
PIMA COUNTY
Santa Catalina Mountains
CORONADO NATIONAL FOREST
10
Rillito River
Santa Cruz River
SAGUARO NATIONAL PARK WEST
Tucson Mountains
River Road
Prince Road
Tanque Verde
Campbell Avenue
Pantano Wash
Craycroft Road
TUCSON
SAGUARO NATIONAL PARK EAST
19
10
0
Miles
6

Rillito River



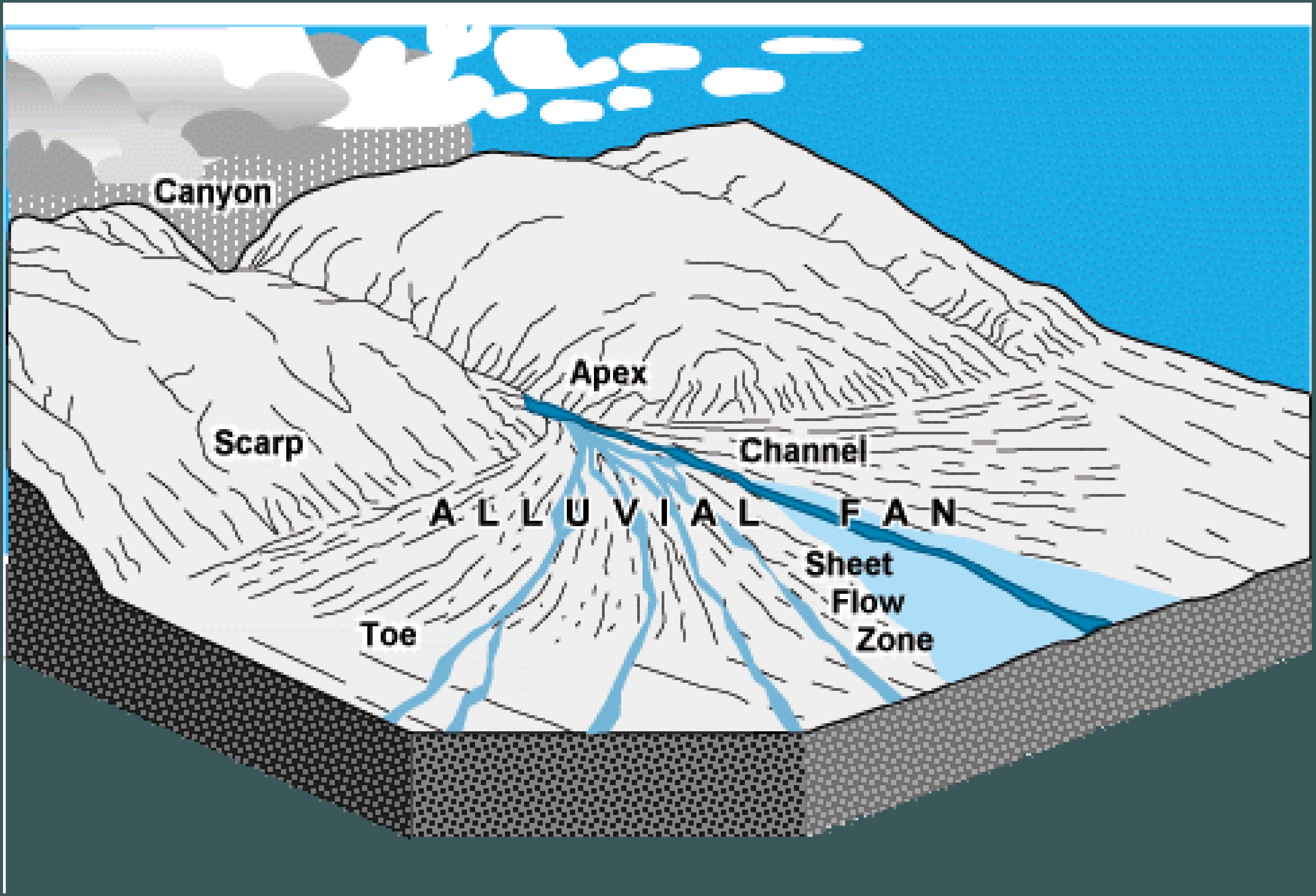

JAN 21 2003

The Corps Returns to Restore –

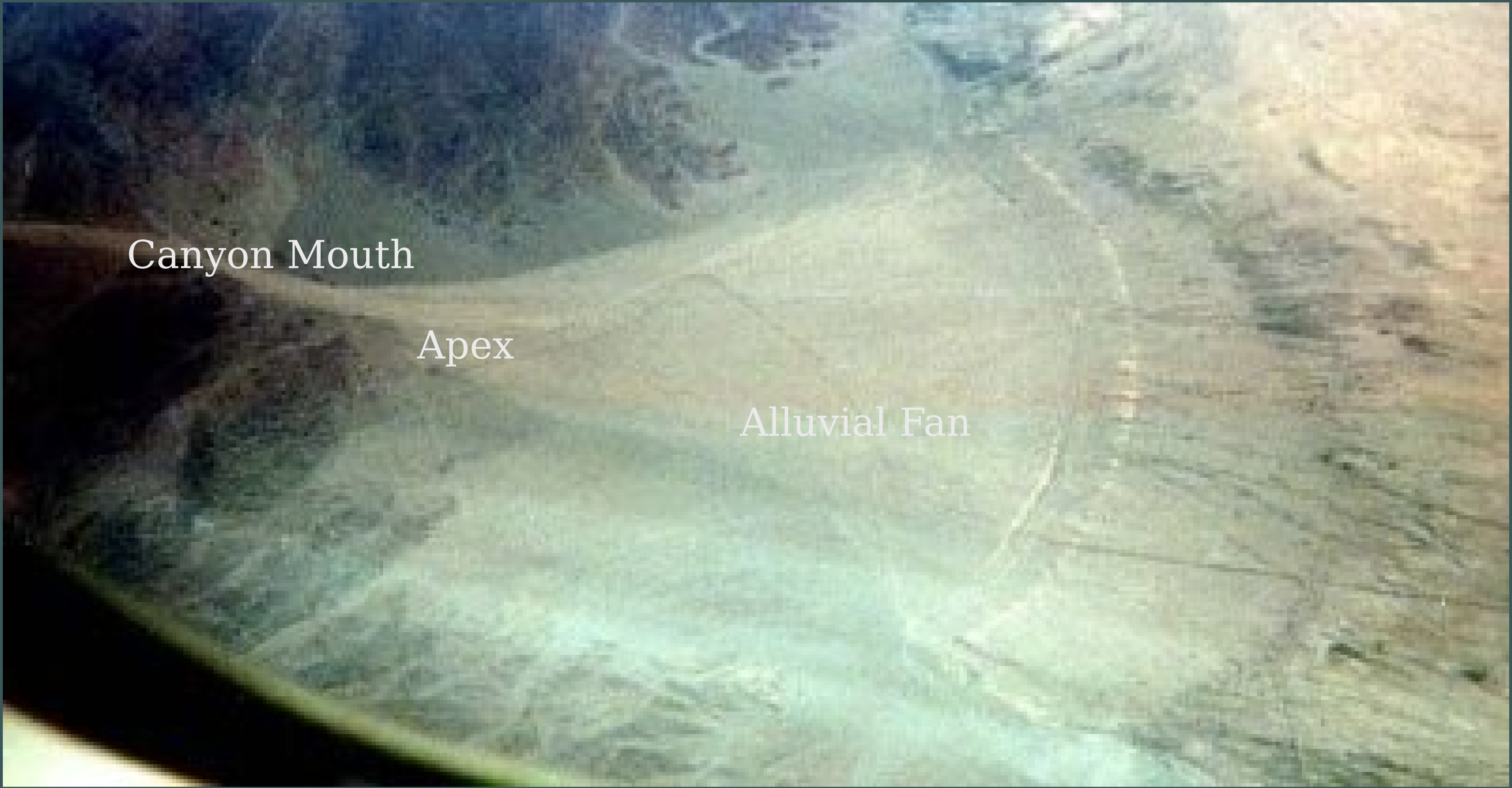

E RIVER RD
Campbell
N CAMPBELL AV
E PRINCE RD
E PRINCE RD
N CAMPBELL AV
E FORT LOWELL RD
E FORT LOWELL RD
N COUNTRY CLUB RD
Bend Area Park
E RIVER RD
N DODGE BL
N DODGE BL
422
420
N ALVERN
E CAMP LOWELL DR
N SWAN RD
N SWAN RD
Existing Swan
N CRAYCROFT RD
N CRAYCROFT RD
Craycroft
P
E FORT LOWELL RD

Alluvial Fans – Lateral Channel Migration

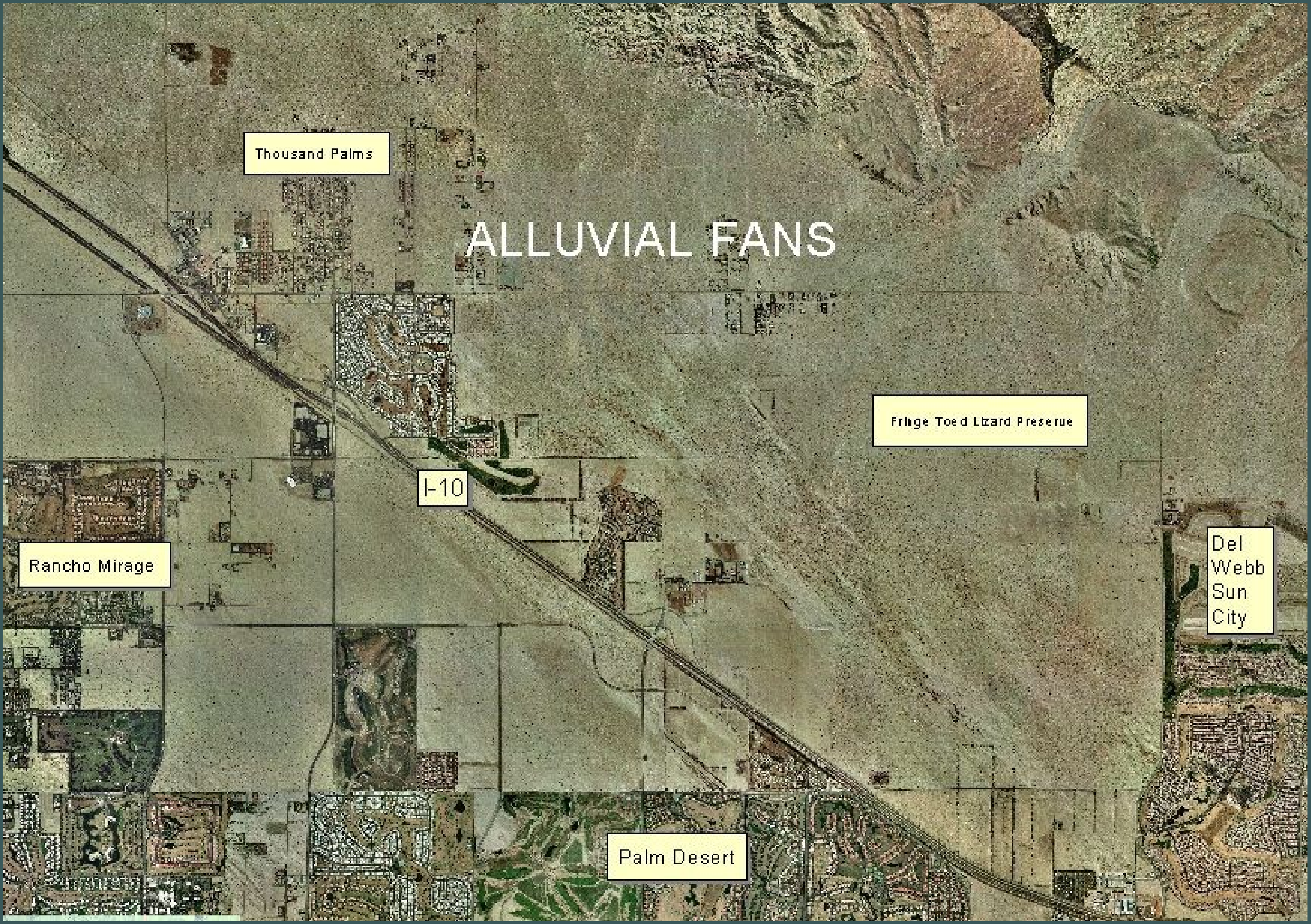
Whitewater, Thousand Palms, CA


Canyon
Apex
Scarp
Channel
ALLUVIAL FAN
Sheet Flow Zone
Toe

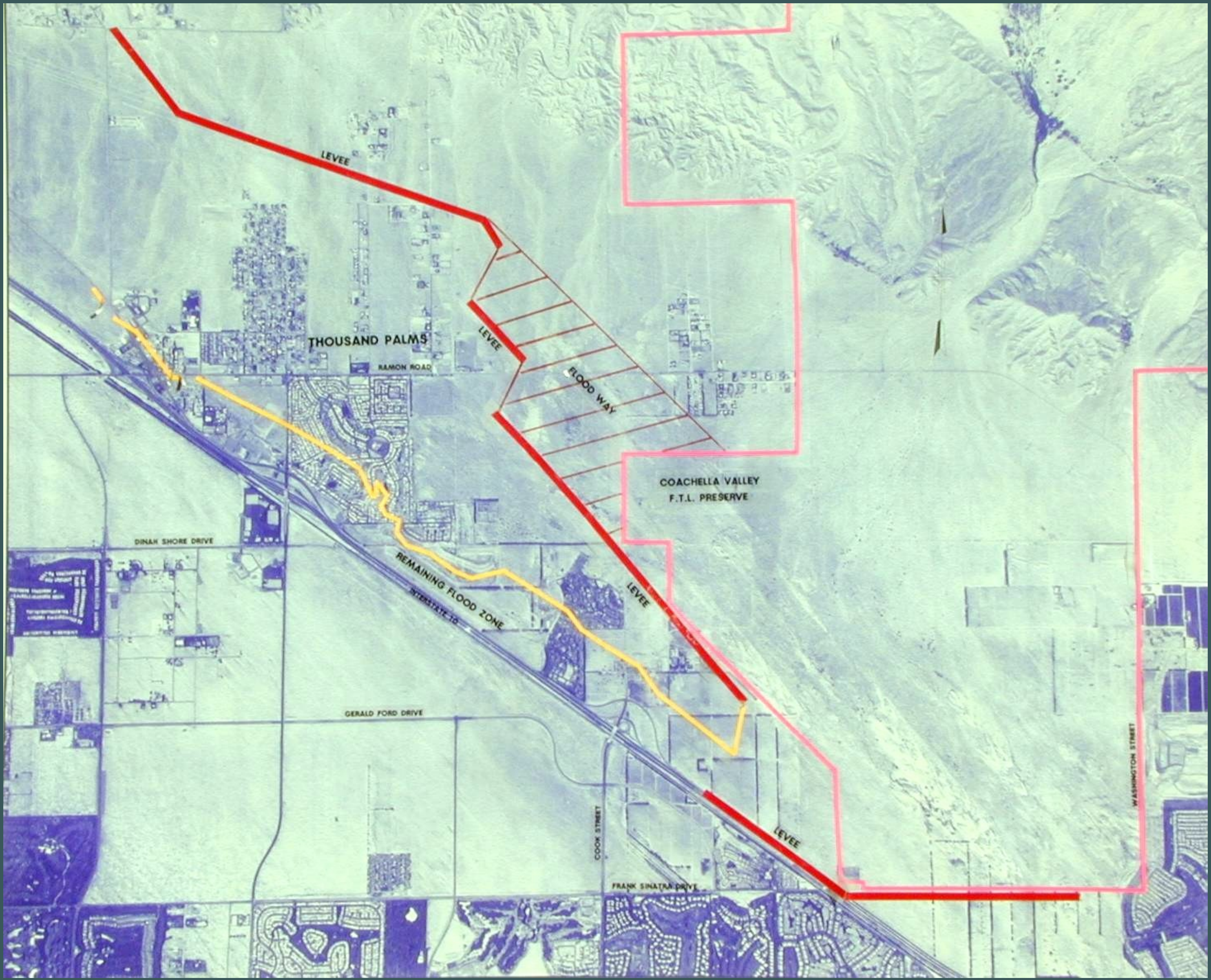
Aerial View of Alluvial Fan (Location Unknown)


Canyon Mouth
Apex
Alluvial Fan

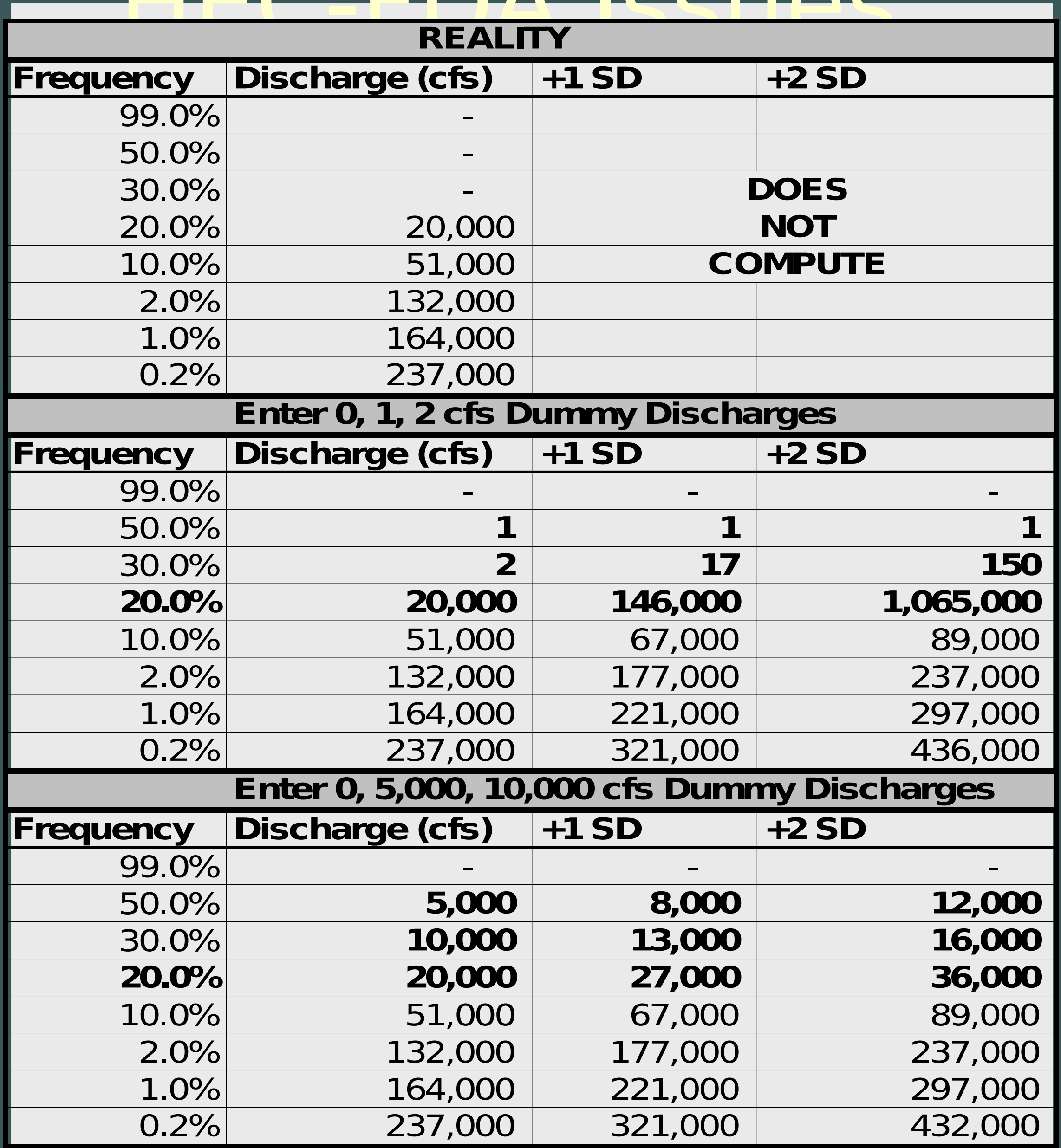
Whitewater Feasibility Study – Thousand Palms, C


Thousand Palms
ALLUVIAL FANS
Fringe Toed Lizard Preserve
I-10
Rancho Mirage
Del Webb Sun City
Palm Desert

Levee Improvement Plan to Protect Whitewater Stud


LEVEE
THOUSAND PALMS
RAMON ROAD
LEVEE
FLOOD WAY
COACHELLA VALLEY
F.T.L. PRESERVE
DINAH SHORE DRIVE
REMAINING FLOOD ZONE
INTERSTATE 10
LEVEE
GERALD FORD DRIVE
COOK STREET
FRANK SINATRA DRIVE
LEVEE
WASHINGTON STREET

HEC-FDA Issues



REALITY

Frequency	Discharge (cfs)	+1 SD	+2 SD
99.0%	-		
50.0%	-		
30.0%	-	**DOES**	
20.0%	20,000	**NOT**	
10.0%	51,000	**COMPUTE**	
2.0%	132,000		
1.0%	164,000		
0.2%	237,000		

Enter 0, 1, 2 cfs Dummy Discharges

Frequency	Discharge (cfs)	+1 SD	+2 SD
99.0%	-	-	-
50.0%	**1**	**1**	**1**
30.0%	**2**	**17**	**150**
20.0%	**20,000**	**146,000**	**1,065,000**
10.0%	51,000	67,000	89,000
2.0%	132,000	177,000	237,000
1.0%	164,000	221,000	297,000
0.2%	237,000	321,000	436,000

Enter 0, 5,000, 10,000 cfs Dummy Discharges

Frequency	Discharge (cfs)	+1 SD	+2 SD
99.0%	-	-	-
50.0%	**5,000**	**8,000**	**12,000**
30.0%	**10,000**	**13,000**	**16,000**
20.0%	**20,000**	**27,000**	**36,000**
10.0%	51,000	67,000	89,000
2.0%	132,000	177,000	237,000
1.0%	164,000	221,000	297,000
0.2%	237,000	321,000	432,000

Frequency/Discharge Function Statistics

-- Have Big Impact on R&U Results

-- Can Vary Widely Based Upon Input Data

-- Must Sometimes be Manipulated to Avoid

Statistical Variations in Frequency/Discharge Stats Using nical Method in HEC-FDA Program – Impacts of Period of R

- Many Arid SW Streams Have Very Limited Period of Record
- Results in Greater R&U in EAD Computations

105 Year Period of Record

Frequency	Discharge (cfs)	+1 SD	+2 SD
99.0%	-	-	-
50.0%	5,000	8,000	12,000
30.0%	10,000	13,000	16,000
20.0%	20,000	27,000	36,000
10.0%	51,000	67,000	89,000
2.0%	132,000	177,000	**237,00**
1.0%	164,000	221,000	**297,00**
0.2%	237,000	321,000	**432,00**

15 Year Period of Record

Frequency	Discharge (cfs)	+1 SD	+2 SD
99.0%	-	-	-
50.0%	5,000	17,000	55,000
30.0%	10,000	19,000	37,000
20.0%	20,000	39,000	74,000
10.0%	51,000	101,000	201,000
2.0%	132,000	271,000	**558,00**
1.0%	164,000	340,000	**705,00**
0.2%	237,000	499,000	**1,050,00**

Questions?